Light and Lighting

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Design and Purpose

AN almost bewildering variety of lighting "fixtures," "fittings," "units" or "illuminators" is available, and for each design its makers—understandably—claim some merits, be these functional, aesthetic or economic. The differences between illuminators in any given class are, presumably, never due to their creators' desire to achieve difference simply for the sake of being different, but because some more laudable purpose has inspired them. It is quite legitimate to rate appearance fairly highly even in designing illuminators for industrial interiors, for it is not in other environments alone that we want our light distributors to please the eye. The trouble is that what pleases some eyes does not please others, and the most a designer can hope for is to achieve a design that will please, or at least not offend, the greatest number. In this matter the designer can seek, if he wishes, the judgment of the Council of Industrial Design, on which are representatives of many shades of taste. So far the path of progress in lighting has been strewn with innumerable illuminators, some monstrous, some elegant, and many merely mediocre. The purpose of an illuminator is to give illumination, but the design of a visible illuminator should also be purposed to please.

Notes and News

About Ourselves

We have noticed that it is the practice of quite a few periodicals to use the first few pages to talk about themselves and though it is a custom that we do not altogether approve of we feel that on occasions such self advertisement can have its uses. For instance we have these two pages to fill with hardly any material available and no time in which to search around; so we propose to talk about ourselves.

Our last issue which dealt at some length with lighting for display in shops appeared to be received quite well; at least we did not receive the jeers we half expected for dealing with such a subject at a time when a ban was placed on all shop window lighting. However, we doubt if the ban will have a very long life — it will probably be quite dead by the end of April.

In this present issue we are dishing up something of a mixed grill. The school lighting series continues with an article from the Building Research Station. Incidentally, we are glad to see that this subject has put a little life into our correspondence column which dried up for a while. We remember being urged some years ago to start a correspondence column again—"so that readers can air their views on this, that, and the other controversy." We were slow to take the hint but eventually gave way—and those who wanted the column so badly and had so much to say, still have not contributed to it.

From time to time there have been comments, favourable and otherwise, in the journal on the work of the Council of Industrial Design. This month we are glad indeed to publish a contribution by the chief information officer of the C.I.D. explaining the aims and objects of the council and appealing for more attention to design in the lighting industry. It is interesting to see that a study is being made of fluorescent lighting in hospitals; we hope that very careful attention will be given to the design of lighting fittings for this purpose, for anything more painful than having to lie on one's back and gaze at some of the fluorescent fittings to be seen to-day, we cannot imagine. There must be a good case for the use of warm coloured lamps in hospital wards as they make one look so very healthy; in the middle of the recent 'flu epidemic, when we were not poorly enough to stay at home but poorly enough to wish we were, people coming into the office used to say how well we looked.

Next on the list is the lighting of aerodrome control rooms where the object appears to be to keep the light out of the eye and on the job. Dr. Dudding's lecture on the tungsten lamp is a reminder to us that the majority of artificial lighting is provided by this means.

Next I.E.S. Meeting In London

The next I.E.S. Sessional meeting in London is a Joint Meeting with the Royal Institute of British Architects and will take place at 66, Portland-place, London, W.1, at 6 p.m., on Tuesday, March 13.

At this meeting a paper entitled "The Lighting of Buildings" will be presented by W. A. Allen and R. G. Hopkinson, both of the Building Research Station. The paper will deal with artificial and natural lighting from the point of view of both the lighting engineer and the architect.

The Faraday Lecture

This year the Faraday Lecture, which has already been given at several places in the provinces, is on "Lamps and Lighting — a Record of Industrial Research," and was given in London on February 14. It is particularly appropriate that the lecturer should be the President of the I.E.S., Mr. L. J. Davies.

The lecture is directed at the general public and Mr. Davies, with many very well staged demonstrations, showed how the efficiency of light production and utilisation had been increased by the research carried out over a number of years by the lamp industry. One has come to expect a high standard of presentation from Mr. Davies and on this occasion the effectiveness of the demonstrations was well appreciated by the audience.

The I.E.S. Annual General Meeting

For several years it has been the practice of the I.E.S. to invite a distinguished visitor from overseas to address the Society following the annual general meeting. As a result the I.E.S. has entertained many of the leading figures in illuminating engineering in the world today and the contributions to lighting knowledge of men like Ward Harrison, Halbertsma, Gaymard and Folcker are better appreciated by lighting engineers in this country.

This year, possibly because it is Festival year—a year in which we blow our own trumpet—the I.E.S. is departing from tradition and the address is to be given by one of our leading physicists, Professor E. N. da C. Andrade. As Director of the Royal Institution Professor Andrade is the present holder of an office which has been held by many distinguished scientists, and it is some measure of the degree of recognition now afforded to the Society and no small honour that he should be giving the lecture this year.

The meeting will be held at 6 p.m. on Tuesday, May 8, at the Royal Institution, and the subject of the address will be "Luminescence." The following evening the I.E.S. are holding their annual dinner-dance.

The Thomas Young Oration

The seventeenth Thomas Young Oration, organised by the Physical Society, was given at the Science Museum on February 23, by Dr. W. D. Wright, who spoke on Modern Problems in Colorimetry. After describing the advances in colorimetry which have been made in the last 25 years Dr. Wright said that though considerable use has been made of colorimetry it is still not as widely understood nor has its technical value been fully exploited. With modern apparatus colour measurements can be reduced to a purely physical procedure, but the more abtruse problems of the present day are concerned less with the experimental methods of measurement than with the correlation of the measurements with what we see. It seems likely that one of the major tasks facing colorimetrists in the future will be the extension of colour measurement to enable the actual appearance of a colour to be specified.

Building Research Congress

The Building Research Congress, which is being held in London from September 11-20, includes a four-day conference on the lighting of buildings. The opening paper, "Brightness and Glare" will be by Dr. Ward Harrison. Other contributors will include Dr. R. G. Hopkinson, Mr. H. C. Weston and Mr. G. Pleijel. The papers will discuss the lighting of schools and factories, daylight lighting and colour. The concluding paper, by Dr. J. W. T. Walsh, will be a general review.

The registration fee for the whole conference is £2 10s., which includes copies of all the preprinted papers bound in three booklets. Excursions and visits are being arranged. Those requiring further information should write to the Organising Secretary, Building Research Station, Watford.

One of a number of attractive examples of floodlighting on the Bruges Canal in Belgium.

Influence of Recent Research on School Lighting

By R. G. HOPKINSON,
B.Sc.(Eng.), Ph.D., M.I.E.E., F.I.E.S.

This is the third in the series of articles on school lighting. It describes how the problem of vision and lighting in schools is being studied at the Building Research Station.

Two major developments in lighting have taken place during the post-war years. One is the fluorescent lamp, which has made artificial light available in greater quantity than practicable with the filament lamp. The other is the use of new building techniques which have permitted, and in fact encouraged, the use of much larger windows than hitherto. As a result high levels of illumination can now be attained much more readily than would have been possible 15 years ago.

The Ministry of Education, in 1945 (6), laid down that the minimum sky factor in a classroom should be not less than 2 per cent., and that the minimum level of artificial lighting should be not less than 10 lm./sq. ft. These were not determined as a result of special researches into the problem of school lighting but were derived from a careful summing-up of existing knowledge, such as that summarised in the I.E.S. Lighting Code of Practice. Recent work confirms that they represent a reasonable standard for present practice. The new schools therefore represent an advance on pre-war practice.

Experience with schools designed to these new levels of illumination has not, however, always been satisfactory. It has been demonstrated that lighting practice, based on design techniques derived from stringent economic considerations, is not yet ready to provide these higher levels of illumination without introducing factors which materially reduce the effectiveness of the new lighting. The chief of these factors is glare.

Glare is really serious in some school lighting schemes, even to prevent the use of classrooms in especially unfavourable conditions. It is particularly bad in rooms with large south windows, without blinds or louvres. In winter the problem is low-angle sun; in summer it is both sun and high-brightness clouds. Under artificial lighting conditions one of the chief problems arises from the use of bare fluorescent lamps at low angles —although the glare problem in artificial light does not assume such serious proportions as under the worst daylight conditions.

The Building Research Station recently completed a series of studies of the problem of school lighting, based on the experience gathered with the new schools. These showed that the answer to the chief problem of school lighting was emphatically not a return to the old conditions of small windows and low level of artificial lighting. What was good enough for our fathers is not good enough for our children. The answer lies, in fact, in a study of the brightness of the whole environment in the classroom, rather than in the level of illumination of the working plane alone. Arising out of this are two principles of lighting:—

(a) The brightness of the main objects of attention should be a little brighter than the brightness of the general environment and should be graded into, and not harshly contrasted with, their immediate surroundings.

(b) The brightness of the light sources should be limited to values which depend upon the brightness of the general environment, and again should be graded into, and not harshly contrasted with, their immediate surroundings.

These principles, which derive directly from experimental studies, are not new, because they underlie the successful design of windows in Gothic cathedrals and Georgian houses, and were appreciated, for

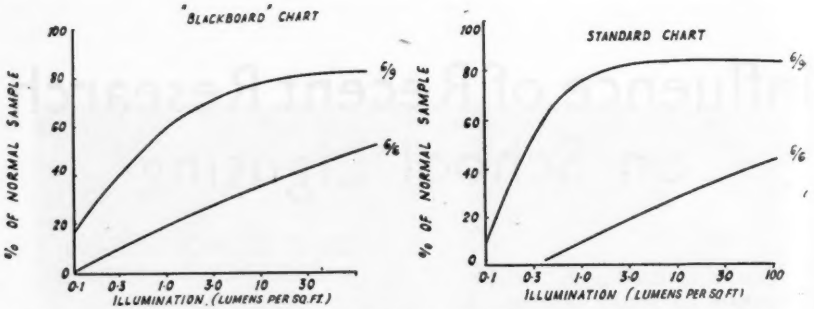

Fig. 1. Proportion of normal sample with acuity better than 6/9 or 6/6 at different illumination levels.

example, by the designers of early prismatic glass lighting fittings. The experimental work has, however, served to put a quantitative assessment on their value in lighting design.

Simple principles are sometimes difficult to apply in practice, and it is often necessary to find out what degree of compromise is acceptable. Much of the recent experimental work has had to be devoted to this aspect of the problem, and hence to study a range of conditions wider than those met with in practice. Reference must be made to the original papers for a detailed discussion (1, 2) but some of the salient points must be summarised here.

Levels of Illumination

It was shown, for example, that although an illumination of 10 lm./sq. ft. is adequate for most school tasks, normal-sighted children derive additional benefit from levels up to those of full daylight. On the other hand, there is a marked falling off in visual performance if the level falls much below 10 lm./sq. ft.; this can be shown in two ways; either an individual child will show a lower performance, or the proportion of children who can perform a given visual task will be less (see Fig. 1). Lighting of the low level described by the author of the first article in this series results in some children straining to perform what should be a simple and automatic visual task, and in others giving up completely, to the detriment of their own education and the discipline of the class. Hence 10 lm./sq. ft. is a suitable value of illumination to prescribe as a *minimum* level for the ordinary visual tasks in a schoolroom.

It was also shown that lighting cannot compensate for poor vision. Children with subnormal vision do show more marked improvement with an increase in lighting level than do children with normal vision, but their improvement is not sufficient to compensate for their disability unless it is only a slight one. Without doubt, myopic children should be given higher levels of lighting than normal children, other factors being the same. However, the best direction to seek improvement in visual performance lies in the increase in the apparent size of the visual task. Under normal conditions, the same improvement in ease of seeing results from moving in 4 ft. towards the chalkboard (18 ft. to 14 ft.) as results from an increase of 30:1 (3 lm./sq. ft. to 100 lm./sq. ft.) in illumination level (see Fig. 2). Similar advantage is gained from increases in the size of reading type. It is in this direction, as well as in increased illumination, that practice should move. The design of the classroom should enable the most distant child to see the chalkboard easily under the proposed lighting conditions. This calls for a close integration of the ideas of lighting with the whole design of the schoolroom at an early stage. If the lighting on the chalkboard is to be 10 lm./sq. ft., no child of age 5 to 9 should be more than 14 ft. from the board, and of age 10 to 15 more than 21 ft. The reason for the age differentiation is that younger children have poorer visual acuity than older children, probably not so much because of physiological as of psychological factors. Secondary and higher education raises special problems, some of which would be solved if instructors would write more clearly on the chalkboard.

Fortunately modern educationists favour informal "group instruction" rather than the more formal methods practised until recently. It is consequently becoming more

rare for children to have to sit at a great distance from the instruction board.

It is necessary to deal at this stage with the question as to whether poor lighting causes or accelerates progressive deterioration of vision in schoolchildren. Recent researches ([3, 4]) demonstrate that many factors are at work in determining such progressive changes, and that bad lighting of itself is not likely to be the cause, although it may be an aggravation. Good lighting can, however, be justified on much sounder foundations than the fear of myopia, and the reader with special interests in this field should consult the recent literature for an appraisal of the problem

Recent work shows, therefore, that there is a minimum level of illumination for school tasks which can be fully justified. On the grounds of visual performance, this level is about 10 lm./sq. ft.; on the grounds of comfort or stimulation it may be higher, but we do not know for certain.

An attempt was, however, made to discover if higher illumination levels influence the ability to learn by visual means. An experiment was conducted jointly by Prof. R. C. Oldfield, the experimental psychologist, and the Building Research Station with the co-operation of the B.T.H. Lighting Section. Children were given a learning task involving a purely visual mode of instruction. Short-term, long-term, and control tests were done to assess the degree of success of the instruction. Comparisons were made at general illumination levels of 3 lm./sq. ft. and 40 lm./sq. ft. The class was divided into two groups, each of which received instruction at each level of illumination in turn. A statistical analysis of the results revealed no evidence that the children had learnt more readily under the higher than under the lower illumination. A slightly more significant factor was the increased facility to profit by the particular form of instruction which came with experience of this type of test. The advantages found by some investigators for increased illumination levels were not, in fact, revealed. On the other hand, an experiment covering a period of years rather than weeks (as did this study) might have been more conclusive. At the moment, however, the minimum level of about 10 lm./sq. ft. appears to be best linked to visual performance or visual acuity standards, rather than to standards f amenity.

The existence of an upper limit of illumination has practical importance in the natural lighting of schools. There appears

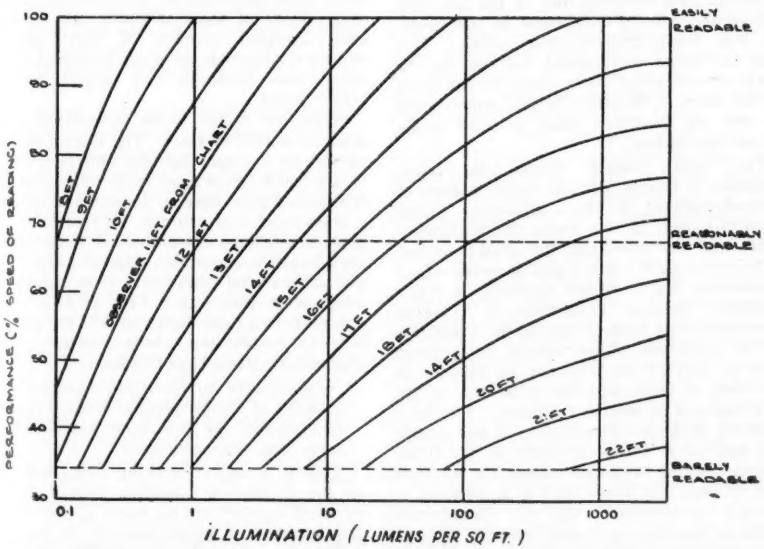

Fig. 2. Effect of illumination on performance. Average speed of reading referred to "Easily Readable" (100%.)

to be no upper limit on grounds of short-term visual performance, at least up to 5,000 lm./sq. ft., but under normal indoor conditions there are complaints of "too much light" when levels exceed about 100 lm./sq. ft. No proper statistical knowledge of the upper limit exists yet, but the evidence indicates that, if it exists, it is based on discomfort from glare from the brightly lighted task, as well as from the windows which provide the illumination.

Brightness and Glare

The influence of the brightness of the environment was demonstrated by Lythgoe ([5]) to be important, judged on the basis of limiting visual acuity. Recent work at the Building Research Station shows, however, that it is equally important judged on the basis of visual comfort. An illumination of 10 lm./sq. ft. on white paper, if produced by local lighting alone (the surroundings consequently being dark) results in discomfort, not indeed bad enough to be called "glare," but sufficiently pronounced for sensitive subjects to consider unacceptable, even on a short-term basis. Optimum visual comfort is obtained under laboratory conditions when the brightness of the local surroundings to the task (e.g., the desk top) is intermediate between that of the task and that of the general brightness in the room, the task being brighter than either. This calls for some preferential lighting on the work, or restrained decorations on the walls of the room. Brightly lighted white walls are not the best for visual comfort under school conditions.

The light sources themselves, either windows or fittings, are the major sources of glare-discomfort in the classroom. Glare manifests itself in two ways, the discomfort effect and the effect on the ability to see. "Disability glare" is not absent under school conditions, but it is not normally a major problem, whereas discomfort is. Glare-discomfort has been shown to be a function of the brightness of the source, its apparent area as seen by the observer, its position in the field of view, and the brightness of the environment in which it is seen. The relationship between these factors is not simple ([2]), and so it is not possible to lay down simple limiting brightness values for windows and fittings, any more than it is possible to specify accurately levels of illumination without introducing compromises. If such compromises are accepted, it can be laid down that under no circumstances should a light source which can be seen have a brightness greater than 2 candles per sq. in. If this value is exceeded, intolerable discomfort will not result, any more than will reading become impossible if less than 10 lm./sq. ft. are received on the book. But a brightness of 2 candles/sq. in. represents a useful limit under normal conditions. It is, however, necessary also to introduce a limit on the apparent area of the source. A brightness of 2 candles/sq. in. for a 6 in. opal sphere seen 10 ft. away is quite acceptable. A 14-in. sphere seen only 6 ft. away would give very uncomfortable glare, and a 6 ft. x 8 ft. window of this brightness would be intolerably bright. It is therefore necessary to employ tables or a formula for the calculation of the glare conditions if one needs to be precise, as is often the case in lighting calculations.

Relief from glare discomfort can be achieved in practice by several methods; small improvements by each of these methods can add up to a substantial gain. These methods include (a) screening the sources from the observer by louvres, blinds, etc.; (b) removing them from the direction of viewing, by higher mounting, for example; (c) reducing their surface brightness, e.g., by the use of muslin curtains over windows, or even low transmission glass; and (d) grading the source brightness into the surroundings by a local surround of intermediate brightness. Each of these methods can apply to both artificial sources of light and to windows, although there are practical limitations, both economic and optical, to their achievement.

A further factor to be considered is the additive nature of glare. The degree of glare caused by a single lighting unit is less than that caused by several such units together. It requires great care to inspect one fitting in a showroom and estimate its freedom from glare under such conditions, if the complete installation is to employ several units. Both discomfort and disability from glare are additive in this way. This additivity is a complex function, however. The simplest way to express the additive nature of the discomfort effects is as follows:—

> *The degree of discomfort caused by a number of similar glare sources is equal to that caused by one such source of the same total apparent area.*

This is a useful working rule, and leads to the interesting corollary that a number of small sources are no more glaring than a less number of larger sources of the same brightness, placed in similar positions relative to the observer. The multitude of sources may make an unpleasing pattern if

badly placed, of course, but no evidence exists for a greater degree of physiological discomfort.

Influence of Recent Work on Lighting Design

The mistake is sometimes made, with each advance in experimental knowledge, of assuming that designers are now faced with a new set of problems; alternatively, the investigator feels surprise that designers have been able to do so well without the aid of his new data. In fact, the truth usually is that the designer, if he is a good designer, has probably already arrived at the same conclusions as the investigator, but by the much more empirical process of experience, reasoning, and intuition, in other words by his skill as a designer. The contribution which the investigator makes is to codify and systematise the findings as part of the general body of knowledge on the subject, to prepare the ground for new advances, and to fill in the gaps in knowledge which the less systematic advances have left.

Recent work on lighting is not likely, therefore, to lead to any outstanding improvement over the best modern practice, but it will have failed if it does not assist the general standard to be raised. The main direction in which improvement can be predicted is a movement away from the "floodlighting" of the working plane by directional fittings of high brightness, and from large windows bare of any blinds, screens or louvres.

The influence of recent work will be to call for:—

(a) General lighting of the whole environment, with some preference for the working plane.
(b) Contrast grading of both light sources and visual task into the general environment.

These requirements both operate against the opal diffusing type of unit. The influence of the architect Gropius and his school of 30 or so years ago should now be discarded as having served its purpose. Many designers of the traditional school expressed their dislike of the "Bauhaus" units at the time of their introduction, and subsequent events have lent some weight to their objections. The opal diffusing unit lights the environment to the same or a higher level than the visual task, whereas a good classroom unit should show some preference to the working plane. The opal unit, in addition, produces a harsh contrast with its immediate surroundings. The older prismatic unit was sometimes better in this respect, although some of these units were much too bright in the centre for comfort. New semi-diffusing plastic materials have good optical characteristics for the design of satisfactory classroom units, but much room for development exists in this field. Modern prismatic units, if not too heavily lamped, probably meet the needs of a normal instruction room as well as any other type of unit at present on the commercial market. New designs, using modern materials, are, however, certain of a welcome from good architects.

The decision whether to employ a few or many units rests on the nature of the school work. Primary schools are tending to concentrate on methods of education which lead to "group activity," the class being divided into several small groups in different parts of the classroom. If the areas in which these activities are to take place can be determined when the room is designed, one unit can be placed over each group to light it selectively. Such a unit should not, however, be a directional unit. Not more than 50 per cent. of the light should fall on to the group, the rest serving to light the ceiling, walls, and the rest of the room. In rooms where more formal methods of instruction are employed, a good case can be made out for a large number of small units. These can be made slightly directional in favour of groups of desks in the formal arrangement. It is important to note that they need not give rise to any more glare-discomfort than a small number of large units, provided they are placed well out of the normal direction of viewing. The greatest objection to multi-point lighting lies at present in the cost of wiring. It does, however, lend itself to selective switching, advocated in the first article in this series. Such selective switching, intelligently arranged to enable the natural daylight to be progressively supplemented, should become a regular feature of a well-lighted classroom.

The Building Research Station is sometimes asked whether it "recommends" fluorescent lighting for school classrooms. The evidence available indicates that no case can be made out on visual grounds in favour either of filament or fluorescent lighting against the other. Fluorescent lighting enables higher levels of lighting to be installed in older buildings without the need for rewiring to take the extra current load. It has been justified on economic grounds, but here much depends on the use to which the artificial lighting is to be put. The criticism to which fluorescent lighting in schools has been subjected can almost always be traced to the installation of units

designed for the cheapest possible lighting of factory areas; such units should not be installed in school classrooms.

Local lighting on the chalkboard is necessary, in order to provide a psychological focus of attention. This lighting should not be much greater than that provided on the desks. It should be uniform, and so placed that no reflected glare results. Chalkboards should not be black. Experimental work has shown that a reflection factor of about 15 per cent. (when white chalk is used for lettering) is best for both visual acuity and visual comfort (1). Chalkboards can be coloured, but not with highly saturated colours. The limiting colour characteristics have been determined (7) by experiment.

Reference has been made previously to room decoration, in order to avoid distractingly high brightnesses of the walls. Present knowledge indicates that walls should have a reflection factor not greater than 60 per cent. Architects are at present working at the Building Research Station on the considerations which govern the decoration of a classroom. On visual grounds it can be demonstrated that very high reflection factors should be avoided. This seems to be confirmed by the architectural studies also, and in some cases reflection factors appreciably below 60 per cent. may be justified.

This summary of recent work on school lighting, and its influence on lighting practice, represents the views of workers placed midway between the specialists in vision and the specialists in illuminating engineering. The problems of neither have been ignored. It is appreciated that much of the bad lighting in schools is due to economic considerations, but it is also true that much is also due to failure to make use of the services of competent engineers or to turn recent knowledge to the best account. Many of the most modern schools, designed and lighted during the period immediately after the war, when money seemed to flow freely into the building of schools, serve literally as glaring examples of misplaced energy in school lighting. Adequate lighting could in many cases have been installed at much less cost. The failure seems to lie in the belief that lighting is an elementary matter that needs no specialist assistance. For success, the school designer needs to know the fundamentals of good lighting himself, and should call in the lighting specialist at an early stage of the design.

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(7) The Choice of Chalkboard Colours (B.R.S. 1949, to be published).

International Commission on Illumination

As announced in an earlier issue, the twelfth meeting of the International Commission on Illumination is to be held in Stockholm from June 26 to July 5. There are already indications that the delegation from this country will be one of the largest from overseas. Of the 36 papers which are to be presented at the meeting, 10 are by authors from this country and are:—

The Optical Properties of Opal Acrylic Plastics. By W. E. Harper.

Illumination and the Variation of Visual Performance with Age. By H. C. Weston.

Colour Adaptation and the Subjective Appearance of Colours. By W. D. Wright.

Rare Gas Discharge Lamps. By J. N. Aldington.

Determination of Recommended Values of Illumination. By H. C. Weston.

Lighting of Galleries and Museums. By W. Allen, J. Bickerdyke, and W. E. Rawson-Bottom.

Subjective Judgments in Lighting Research. By R. G. Hopkinson.

The Problems Associated with Underground Lighting in British Coal Mines. By D. A. Strachan.

Visibility in Thick Fog from the Point of View of Road Transport. By A. G. Harris.

Dark Adaptation and Miners' Nystagmus. By W. J. Wellwood Ferguson and F. W. Sharpley.

The programme also includes, in addition to the other papers which are to be presented from authors from several other countries, the reports of the secretariat committees on the various subjects studied by the Commission.

A complete record of the meeting, including the reports and papers, will be available in due course. Those wishing to reserve copies may do so through the National Illumination Committee.

Industrial Design and the Lighting Industry

There is no doubt that there is plenty of scope for design in lighting fittings particularly those for use with fluorescent lamps. In this article the author, who is with the Council of Industrial Design, explains the aims and objects of the Council and calls upon the lighting industry to encourage good design.

By PAUL REILLY*

One of the commonest misconceptions about the Council of Industrial Design is that it wishes to foist an official taste on a long-suffering public. It is often forgotten that the Council has no executive powers; it exercises no veto; it has no authority to tell manufacturers to make one design or not to make another. It is an advisory body charged with the difficult task of improving standards of design in British manufactures by all practicable means short of compulsion. The fact that its activities are financed from public funds probably lays it open to a greater measure of criticism than if it were a voluntary organisation or one supported by private endowment.

The Council is an easy target for all who are satisfied with things as they are; if one does not recognise a need for improvement, any organisation set up to improve is bound to appear an unwarrantable extravagance. On the other hand, if one accepts that there is a job to be done one must also accept that those who are trying to do it should express their views and preferences as forcibly as they can. Though the Council is single-minded in its purpose of raising standards of industrial design, there are probably as many shades of taste represented at its deliberations as there are members at the table. Catholicity in selection, consistent with a proper regard for quality in its widest sense, has always been one of the cardinal principles in its propaganda. Yet it is no accident that a recognisable style has come to be associated with the Council's exhibitions.

In any period of healthy design—whether in architecture or interior decoration—there have been artists and designers who have led the field. Robert Adam was a revolutionary influence in his own day, just as Picasso or Le Corbusier have been in theirs. Had there been a Council of Industrial Design in 1760 there is no doubt that it would have encouraged the young Adam brothers. The headquarters of the only comparable body, the Society for the Encouragement of the Arts, Manufactures and Commerce in Great Britain, was in fact designed by Adam. Were the Council ever to achieve a new headquarters it is to be hoped that one of the younger contemporary architects would be commissioned to design it.

There is no cause for alarm and despondency in this. The scales are still heavily weighted in favour of safe, commercially proven designs, but it is only common prudence to look forwards as well as backwards. Nothing would be easier or more popular for the Council of Industrial Design than to slap everyone on the back and to pick its exhibits straight out of the shop windows.

The choice between bad and worse presents no problem in most industries. There is no difficulty at all in finding facsimiles (or, easier still, near misses) of past successes. But to find designs that fulfil all the functions and requirements of present-day use, that satisfy our natural urges for domestic harmony, that give the appearance as well as the reality of value for money and that are also eminently contemporary in character is still like looking for needles in haystacks.

There is probably no industry to-day that so well reflects all these problems of industrial design or that exerts so dominant an influence in daily life as the lighting industry. And it differs from many other domestic industries in one important respect.

* Chief Information Officer, The Council of Industrial Design.

Whereas its function, like that of furniture, glass, pottery or carpets, has remained the same from generation to generation, two technical revolutions have occurred in the industry within the past 150 years—the introduction of two new sources of light, first gas and then electricity. Had the industry been on its toes at these times it could have made the presentation of these new forms of light as original and interesting as their production, for not only had lighting progressed from candles through oil lamps and gas lights to electricity but manufacturing techniques had also advanced from forging and casting to pressing, extruding and welding. But both revolutions happened at a time of design debility, when the line of least resistance was eagerly followed; the easiest solution was, of course, to make the new forms of lighting as nearly like the old as possible, and this has continued to the present day; the ghosts of the wax candle and the shaded oil lamp are still with us.

Between the two wars there were some valiant attempts to give electric light fittings more logical forms, but these were in the main acceptable only for kitchens, bathrooms, hospitals or offices. The industry could still offer little in the way of sensible contemporary design that was also acceptable for the homely living-room. As has been said elsewhere, "there has seemed, in this industry, to be no half-way house between the functional or clinical and the lush suburban, between the frosted football and the scalloped bowl, between the bathroom wall strip and the parchment-shaded electric candle or between the office desk light and the over-hatted vase."*

That is why the Council of Industrial Design has taken an interest in the work of foreign designers, why its Scottish Committee staged an exhibition of Scandinavian and Italian light fittings, why it welcomes such displays as that by the Scottish Furniture Manufacturers at the 1950 British Industries Fair, and why it backs those pioneer firms which try something new, not just for the sake of novelty but in an attempt to produce fittings which make sense by twentieth-century standards.

There is probably no industry that offers more scope to the industrial designer for the exercise of all his talents, for domestic lighting lies mid-way between art and engineering; the need is for something decorative, something functional and, if one accepts the premise of the Council of Industrial Design, something which is honestly contemporary. It is a tough enough assignment for any designer, but how many manufacturers are facing up to it? The temptation is to say it can't be done and to carry on with the dull, mechanical forms of the "fitness for purpose" school or with the coy make-believe of electric lanterns and plaster candles or with the tawdry finery of the standard lamp shade.

The attitude of the industry to design has again become of paramount importance, for yet another revolution is taking place. The introduction of fluorescent lighting presents problems even more complicated than did the incandescent bulb (for these new tubes are not readily adaptable to the old familiar forms), but the temptations of fancy dress and applied embellishment are probably as strong as ever. Whether the industry will rise to the occasion and produce designs which are neither bald nor titivated engineering but are things of use and beauty remains to be seen. The contents of the 1951 Stock List suggests that several makers are tackling these new problems in the right way by calling in the designer at the very outset of the project instead of inviting him to add the "art" as an afterthought. The proper employment of the designer, whether a staff designer or an outside consultant, is one of the major concerns of the Council of Industrial Design. The experience of its industrial officers and the services of the Record of Designers are always available to manufacturers in the lighting as in any other industry.

* "Design," No. 15, page 2.

Optical Trade Exhibition

Directly following the International Ophthalmic Optical Congress, which the British Optical Association are sponsoring in London from July 10—13, the British Ophthalmic Optical Industry are presenting a comprehensive exhibition at the Royal Horticultural Society from July 16—20. Nearly 100 firms will be exhibiting their products, which will cover every phase of ophthalmic optical production. There will also be demonstrations of new instruments, apparatus, and techniques.

All those interested, either directly or indirectly, in the optical profession and industry will thus have an excellent opportunity to learn about the latest British activities in this field. Further information can be obtained from the organisers, the Association of Wholesale and Manufacturing Opticians, 69, Cannon-street, London, E.C.4.

Fluorescent Lighting in the Hospital

By J. K. FRISBY*

Poor lighting in hospitals can react most unfavourably on patients and staff alike. Good lighting, carefully controlled to avoid glare, can make both the hospital ward and the patient more cheerful. In this article the application of fluorescent lamps to this field of lighting is discussed.

In hospital work of all kinds the greatest possible emphasis is placed on perfect cleanliness as one of the most important factors in the prevention of the spread of disease. Experience has shown that, in all types of interiors, an improvement in lighting conditions has resulted in more efficient cleaning; this is particularly true when fluorescent lamps are used. Dirt and dust collect in dark corners, but with properly planned fluorescent lighting there are no dark corners.

For this reason fluorescent lamps are being used for lighting in many hospitals, and it is, therefore, of interest to record the information that has been gained as a result of experience in this field. Only areas of special importance, or which provide particular lighting problems, are dealt with.

The Operating Theatre

In very few visual tasks is there such a need for quick and easy vision as there is in the critical task of the surgeon. The penalty for indifferent lighting conditions may be, at the worst, the loss of a life, and, at the best, the imposition of great visual strain which must result in a reduction in safe and efficient manipulation of the surgical instruments. Broadly speaking, the lighting requirements in the operating theatre are:—

(a) The provision of a concentrated light that can be focused at a point or made to cover an area of from 12/15 inches diameter by simple adjustment.

(b) Easy alteration of the position of the "spot" of light, and the direction from which it emanates.

(c) Complete freedom from shadow at the seat of the operation, even when the surgeon and staff are gathered round and leaning over the table.

(d) Good colour rendering of the light by which means the surgeon and anaesthetist may judge the changing conditions of the patient. (A *familiar* colour rendering is perhaps more important than a *good* rendering as judged by daylight standards.)

(e) The use of a light source having a minimum of infra-red radiation, thus reducing discomfort to the surgeon.

(f) Freedom from glare, either direct or reflected, which causes eyestrain resulting in excessive fatigue on the part of the surgeon.

Experiments with the use of the 80-watt fluorescent lamp over the operating table have determined the fact that this type of light source fulfils the requirements of paragraphs (c) and (e) 100 per cent., in fact to a much greater degree than does the incandescent filament lamp. In regard to requirement (d), the question of colour rendering is largely a matter of adaptation. In using a light source different from the one that has been in use for many years, it is necessary for the surgeon and anaesthetist to become accustomed to the slightly different appearance of the flesh and tissues. The warm white fluorescent lamp has been found to be more satisfactory than other colours, but future developments may possibly produce a lamp of even greater value in this respect.

The fluorescent lamp is of great value in aiding a reduction in direct glare due to its

* Registered Lighting Engineer (I.E.S.), The British Thomson-Houston Co., Ltd.

low surface brightness. It is not only direct glare that has to be considered, however, and it must be remembered that the light from fluorescent lamps covers the whole of the operative area to a high intensity. The total light flux reflected from this area, approximately 6 ft. × 18 in., is considerable, and when white drapes are used over the patient can cause considerable glare. This problem is easily overcome, however, by the use of coloured sheets, preferably dark green. This not only reduces the glare effect, but aids concentration of attention on the area of the operation.

In considering requirements (a) and (b) we find certain limitations in the fluorescent lamp. It should be emphasised that this lamp was designed with the express purpose of providing diffused illumination and is a large area low-brightness source. The light from it cannot by any reasonable equipment or optical skill be concentrated into a high candlepower beam in a particular direction. If this were possible it would do no more than defeat the purpose for which the lamp was originally intended. Fluorescent lamps, therefore, should not be used in operating theatres unless they are supplemented by adjustable highly concentrated spotlights for deep cavity work; otherwise the results may be disappointing and the fluorescent lamp may be the subject of undeserved criticism. In addition to adjustable spotlights for cavity-work fittings using fluorescent lamps should also contain pre-focused filament lamps wired to the emergency supply which will come into operation immediately on failure of the mains. It this method is employed together with a battery-operated portable spotlight safety and satisfaction will be ensured.

X-Ray Departments

General lighting in the X-ray department does not present any special problem, being merely the provision of adequate illumination from an installation designed in accordance with accepted codes of practice. Two special requirements, however, are worthy of note, the first being the lighting of the room used for fluoroscopy.

In this area the radiologist views the shadows on a screen of extremely low brightness, and in order to discern the critical detail it is necessary for his eyes to be adapted to conditions of almost complete darkness. This takes anything from 15 to 20 minutes to achieve and it is necessary, therefore, to have some special form of lighting which can be used during the diagnostic process when patients are to be moved to and from the screen.

If the normal room lights are used the adaptation of the eye is destroyed each time they are switched on and the work of the radiologist is held up accordingly. It has been found, however, that a low intensity of coloured lighting, preferably red, may be used which is sufficient to provide illumination for safe movement and yet will not destroy the dark adaptation of the eye. In order to make the most of this lighting the lamp should be large and of a low brightness, such as a 4-ft. 40-watt fluorescent lamp. It should be completely screened by a deep-red filter glass and should be used as a totally indirect light source. That is to say, the light should all be directed on to the ceiling through the red filter and no direct rays should be permitted. Some experiments may be necessary to determine the density of the filter glass to use in conjunction with a particular ceiling colour, but the principle is perfectly satisfactory in providing illumination of the required low brightness.

The second application worthy of note is in connection with radiography. In diagnostic work the radiographs are held before a luminous panel or series of panels. The requirements for successful examination are that these panels should be of even brightness over their whole surface, that the colour should be white and the panels must be kept cool to prevent curling of the film. When using a hot, reddish-coloured light source these requirements are difficult to meet, and an uneconomical optical system using reflectors and filter glasses is necessary.

The fluorescent lamp, however, has properties of size, colour and brightness which make it ideal for this purpose, and four 18-in. lamps, used vertically, will be found adequate for lighting a 17-in. and 14-in. panel. If a high brightness "spotting" panel is required for extra dense areas of film a low-voltage tungsten lamp with a silvered reflector covered with frosted glass will be found satisfactory.

Ward Lighting

In considering the existing practice in ward lighting it would appear that the requirements of the patients have not been studied sufficiently to ensure easy glare-free vision. Planning of the lighting in hospital wards has followed a standardised pattern based on a row of pendant fittings down the centre of the ward, supplemented by bed-head lighting with small localised fittings. Whatever type of fitting is used in the centre of

the room the result is to provide a higher intensity of illumination in the gangway between the ends of the beds, falling off rapidly towards the sides of the room where the patients are normally located. When patients are sitting up, or are in a reclining position, they are looking directly at the lighting fittings, and even if the lamps are screened to prevent a direct view the patient receives no useful light on his book or papers, etc. Furthermore, though the localised lighting may help the individual patient it can be a source of annoyance and discomfort to those on the other side of the room, particularly if the light is wrongly adjusted.

In building up a sound optical specification for ward lighting one must consider the desirability of providing a low level of illumination in the centre of the room, sufficient only to promote safe movement of staff, food trolleys and patients, and a higher intensity suitable for reading, writing, sewing and medical examination down either side. This suggests that two rows of fittings are necessary, one down either side, and Fig. 1 shows graphically a comparison of the usual and desirable distributions of illumination.

Having reached this stage, one must next consider the direction from which the lighting must come to be of maximum benefit to patients and staff. Except when patients are very ill they are normally propped up in a

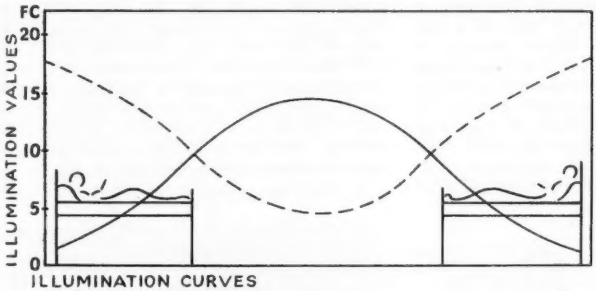

Fig. 1.

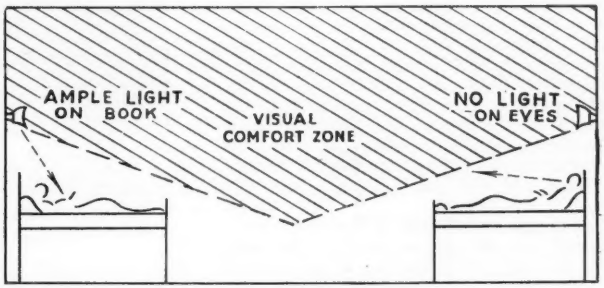

Fig. 2.

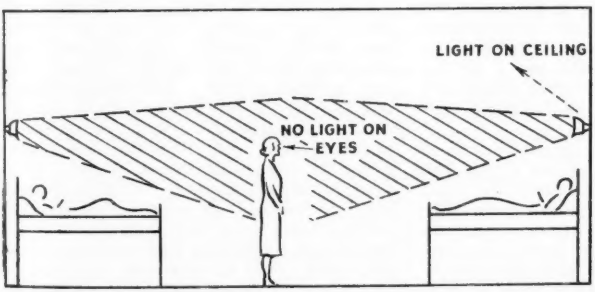

Fig. 3.

sitting or reclining attitude. For lighting to be of the most benefit to them the illumination should fall on their books or sewing from behind their heads. This locates the fittings, for optimum results, on the walls of the ward, but no lamps or high-brightness images should be visible to patients on one side of the room from fittings on the opposite side. Fig. 2 shows how lamps should be screened to secure this result.

For general illumination of the ward a perfectly even distribution of light, of a low order if there are no visible sources, is adequate and desirable. From a visual point of view totally indirect illumination provides the softest and most comfortable conditions, and there is every advantage in providing this indirect component from the same units mounted on the walls as are used to provide localised lighting for the patients. All that is needed is a second lamp in the top of the fitting designed to throw the light upwards and outwards. The final distribution is shown in Fig. 3. From the above we can build up an optical specification which will provide, in theory, ideal ward lighting conditions.

Practical considerations regarding type of lamp, size of the fitting, wiring circuit and possible movement of beds must be given attention and these have been satisfactorily answered only as a result of experience and experiment. In choice of lamp the most suitable type was found to be the fluorescent, as due to its high efficiency it could be used as an indirect source with economy. Furthermore the low surface brightness of this lamp is such that little discomfort is likely to be caused even if a patient did lie back and look directly at it. It is an advantage to ensure that the switching arrangement is such that the lower lamp in the fitting can be turned off when not required, while all the upper lamps are permanently on one circuit to ensure even general illumination.

Owing to the unfortunate overcrowding of hospitals these days it is sometimes necessary to have more beds in a ward than originally intended. This means that the fittings must be physically flexible so that it is always possible to arrange one fitting over each bed however many there are in the ward. This requirement is met by installing continuous double rails of aluminium tube along both walls of the ward at a height of just over 6 ft. from the floor. The fittings are made with suitable hooks on the back and a short flexible lead which may be inserted in socket outlets placed at intervals along the top tube carrying the power supply. This arrangement is shown diagramatically in Fig. 4.

In reaching a decision regarding the length of the fitting it is necessary to consider the cost of the equipment and the size of the lamp which is suitable. The original fittings used 4-ft. lamps but the size of lamp was later reduced to 3 ft. The original fittings had flaps at the top and bottom to cut off the light as required but these proved costly to manufacture and it was decided to use two 3-ft. 30-watt fluorescent lamps with a solid baffle between them. The lower one could be switched off when not needed and no adjustable parts were required. This ensured an economical and very functional unit which could be marketed for a reasonable figure. The unit is illustrated in Fig. 5.

Warm white lamps have been found to be most suitable although now the Mellow lamp is available in the 30-watt size it may be an advantage to use this in the lower part of the fitting with a natural or warm white lamp for the upward component. Whichever

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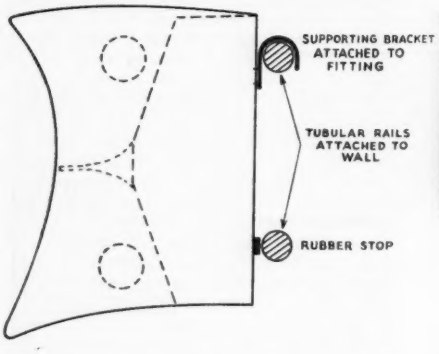


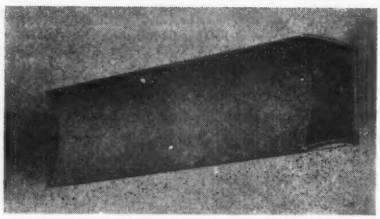


Fig. 4. *(left)* **Sectional drawing of wall fitting illustrated in Fig. 5.** *(above).*

The Lighting of Aerodrome Control Rooms

By S. S. BEGGS,*
M.A., F.I.E.S.

We are all familiar with the difficulty of seeing through a window at night time with lights behind us. This is the problem which has to be overcome in lighting the Control Room at an aerodrome, and this article records one way in which this has been done at the London and Northolt Airports.

The Air Traffic Controller at a civil airport is responsible for the safety of aircraft approaching to land or leaving the airfield, and a clear view of the ground traffic within the landing area is of great advantage. The lighting of the Aerodrome Control Room at night so as not to interfere with such a view presents a difficult problem, the solution of which is discussed in this article.

Introduction

At a civil airport, the pilot of an aircraft approaching to land or about to take off is given instructions and information by radio telephone from the airport. The centre with which he is in communication is the Air Traffic Control, and for the last stage of the approach and landing or the final clearance to leave, direction is taken over by an officer in the Aerodrome Control Room. This is usually a small room, perched on the top of the Control Tower, and glazed on all sides so as to give the Controller a clear view in all directions, and in particular over the runways and taxiways of the landing area. His desk is generally close up to the window on the airport side of the room. Although it may not be absolutely essential, it is a great advantage for him to see vehicles on the roadways within the landing area, and to watch the flight of the aircraft as it lands or takes off.

* Research Laboratories of The General Electric Company, Limited, Wembley, England.

The Problem

At night most of the landing area presents a vast extent of almost utter darkness and if the Controller is to perceive anything useful it is essential that his eyes should be adapted to the darkness, so far as possible.

At the same time he has to record data, such as the time of arrival or departure of an aircraft or information passed to him by telephone, and to read instruments and typed or printed papers such as instructions and weather reports. He therefore requires an illumination of his desk sufficient for these purposes, and the problem is to provide adequate visibility of such documents without destroying visibility of movements of vehicles and aircraft over the landing area.

The problem is complicated by the expanse of window glazing, for the interior of the room is reflected in the glass, tending to obscure completely all outside objects and to confuse the pattern of ground lights. As the desk is close to the window the reflection of the Controller himself may be a source of trouble.

Special devices, such as internal lighting of instrument dials, can be of great value, but only the general lighting, which provides the major problem in so far as external visibility is concerned, will be considered here.

Early Methods of Attacking the Problem

The lighting of Control Rooms has not previously received consideration as a whole. This is partly because existing Control Towers have not been built to any unified design; most have been enlarged and adapted from existing buildings as the aerodrome grew in capacity and importance (sometimes being relics of R.A.F. usage), and ideas have changed so rapidly that no stable system has

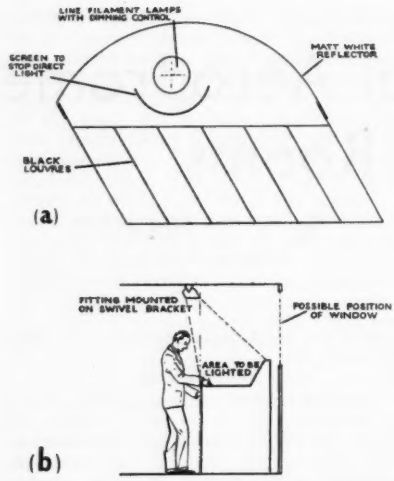


Fig. 1. Type of lighting fitting and its location relative to the desk and Controller.

developed. Some later Control Rooms have been constructed with sloping windows, to avoid the undesirable reflections obtained in the usual vertical glazing. This has been of considerable help, but stray reflections may still be obtained; also such a construction is not representative of the many existing buildings.

Most of the methods of lighting attempted by the individual aerodrome staffs have been in the nature of local lighting units attached to the sloping face which forms the farther boundary of the desk top, and on which are mounted loud-speakers, instrument dials and switches, and certain information and record charts. A simple ceiling fitting in the centre of the room sometimes provided general lighting, but with this in use the reflections in the windows proved very distracting.

The main objections to the local shielded light attached to the desk were the marked diversity of illumination and brightness over the desk top, and the great contrast beween the bright sloping panel and the dark outdoor scene in close juxtaposition in the line of sight of the Controller. Also reflections of the lamps in shiny surfaces were liable to be a source of glare.

The local light was sometimes provided with dimming control, but even then it was usually set at normal full lamp brilliance at dusk and not subsequently altered, as some parts of the desk were always inadequately illuminated.

In America the use of deep red light was proposed, as causing negligible interference with dark adaptation of the eye. However, at the brightness levels involved little is gained by the use of coloured light, and there is always the danger of red markings, e.g., on a chart, being overlooked, since they become almost invisible. In practice operators dislike working under the strongly coloured light, and the red filters tried in some American Control Rooms were generally removed after a short trial.

An alternative American proposal was the use of ultra-violet light, and fluorescent materials for dial and switch markings and for the pencils used for recording data. Although such a method sounds attractive, there are many difficulties. For example, its application is very limited; normal typed or printed matter cannot be read. Also many ordinary materials fluoresce to a small degree and some (for example, often a laundered shirt or handkerchief) quite brightly, which may have unexpected effects; and if any of the u.v. radiation falls directly on the eyes of the Controller the apparent haze produced by fluorescence within the eyeball itself is disturbing.

A low level of ordinary white light pro-

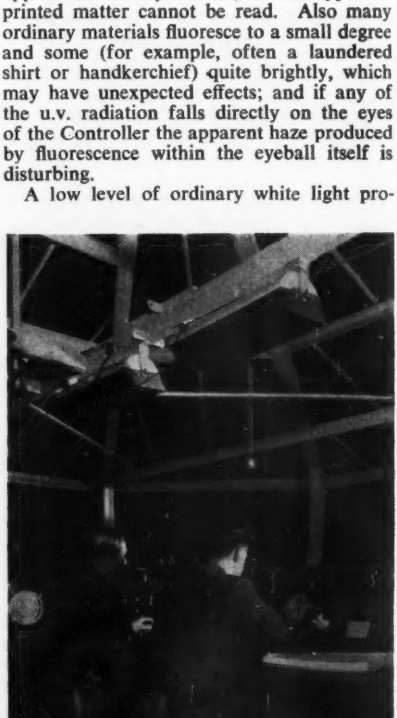


Fig. 2. Fittings installed in Control Room at Northolt Airport.

perly controlled therefore seems preferable to other schemes that have been proposed or tried out.

Proposed Solution

A study of the operational procedure showed that the requirements of the lighting were :

(1) A sensibly uniform low level of illumination of the whole of the desk top, and

(2) Minimum illumination of all other objects (especially other than horizontal surfaces), including the face of the Controller himself.

The first requirement indicated localised lighting units mounted well above the desk, rather than local lights attached to it. The location of the units is of considerable importance, in order that reflections in polished or glossy surfaces on the desk shall not be visible to the Controller. The desk itself may have a fair amount of gloss, and although the documents handled are usually fairly matt, some charts and the like are covered with transparent plastic material. If the lighting fittings are mounted over or in front of the desk there is every likelihood of some bright reflection being close to the line of sight of the observer. The best position for the fitting is almost above the head of the Controller, with the light directed forward at an angle of about 30 deg. to the vertical; reflections in surfaces which are either nearly horizontal or nearly vertical (such as the desk top or its sloping back) then fall outside his field of view.

In order to meet the second requirement, the illuminated area must be restricted fairly closely to the desk top. The size of desk varies, and there may be other control tables in the room (such as the ground-lighting control panel), which require lighting similarly. It would appear most convenient to adopt a standard unit area of about 4 feet by 2 feet for illumination by each lighting fitting. One fitting would then be used for each operator position in the room, and the level of illumination would be sufficiently low for additional general lighting by artificial light to be unnecessary. For a two-position desk (as is fairly common) two fittings can be mounted in line, and small variations in area can be met by slight adjustment of the mounting height and inclination of the fitting. The light must be sufficiently diffused to avoid heavy shadows on the desk, but must be controlled in direction in order that spill light may be reduced to a minimum, and particularly to ensure that the head and shoulders of the Controller, just above whose head the fitting is mounted, are not strongly illuminated.

The Lighting Fitting

Such delicate control can be achieved most simply by diffuse reflection and relatively deep louvres to control the direction of emission of the light.

As the area to be illuminated is rectangular, a trough reflector is very suitable. A line source along the axis of the trough provides greater uniformity of illumination than is possible with small lamps, and to obtain a minimum diversity of illumination direct light should be shielded.

The louvres must be black, to avoid scattered light, and their depth must be several times their separation longitudinally in order to obtain the relatively narrow rectangle of illuminated area. They must be inclined at about 30 deg. to the vertical, to give the correct directional control of the light; also their lower edges must lie approximately in a horizontal plane, to avoid their surface presenting a disturbing bright area, either directly or by reflection in the facing window, within the field of view of the Controller.

The elements of such a fitting and its mounting relative to the area to be lighted are indicated in Fig. 1.

Trial Installations

At the request of the Ministry of Civil Aviation, two experimental fittings were installed in the autumn of 1949 in the Aerodrome Control Room at London Airport. At that time this was a particularly difficult room, because of its small size and the closeness of the desk to the glazing. The new lighting scheme gained the approval of the Controllers who worked with it, but the fittings had to be removed after a short while, on account of structural alterations to the Control Tower.

Two prototype fittings were then mounted in the Aerodrome Control Room at Northolt Airport, and these are seen in Fig. 2. Each contains two 30-watt line filament lamps. Incandescent filament lamps are preferable to electric discharge lamps here because of their simplicity and ease of dimming; as only a low level of illumination over a restricted area is required, the higher efficiency of the discharge lamp is not of significant advantage.

The circuit includes control of the voltage

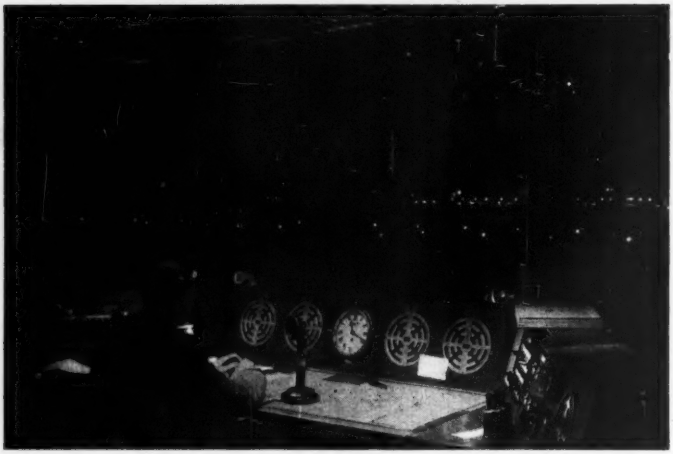


Fig. 3. View of Control Room at Northolt Airport in use at night.

applied to the lamps, and the illumination on the desk top can be adjusted by the Controller to any value between zero and approximately 2 lumens per sq. ft. This value is the maximum which it is considered desirable to provide, as it is more than is required for general use and yet is not so high as seriously to prejudice visibility of the external scene if the Controller is called upon at short notice. The diversity of illumination over the working area of the desk does not exceed 2:1.

The appearance of the installation in use is seen in Fig. 3. The Air Traffic Control Officers at Northolt like the lighting, and consider it very good. The installation has also been inspected by other Air Traffic Control Officers from two of the four Divisional regions under the supervision of the Ministry of Civil Aviation, and has met with general approval.

SITUATIONS VACANT

SALES ENGINEER required to operate in area covered by Merseyside and North Wales Electricity Board. Preference given to Registered Lighting Engineer (I.E.S.) or Corporate Member I.E.S. Write, in confidence, giving full details of education, experience, past and present employment, and remuneration required, to Area Manager, Benjamin Electric, Ltd., 5, Corporation-street, Birmingham, 2.

LIGHTING ENGINEERING ASSISTANT for the preparation of technical publications and similar duties. Applicants should possess a good general knowledge of tungsten and fluorescent lamps and lighting equipment. Minimum qualification—National Certificate in Electrical Engineering or equivalent. The appointment carries a good salary and is pensionable. Write, giving full details of experience, age, etc., to Chief Technical Engineer, Ekco-Ensign Electric, Ltd., 5, Vigo-street, London, W.1.

LIGHTING ENGINEER required in the Illuminating Engineering Dept. of Ekco-Ensign Electric, Ltd. Applicants should be fully conversant with methods of modern lighting practice, and possess a good general knowledge of Lamps and Lighting Equipment. The work will entail the preparation of Lighting Schemes, specifications, quotations, reports, etc., and interviewing prospective customers. Membership of the I.E.S., though not essential, will be regarded as an asset. The appointment carries a good salary and is pensionable. Write, giving full details of experience, age, etc., to Chief Illuminating Engineer, 5, Vigo-street, London, W.1.

ILLUMINATING ENGINEER, experienced in modern lighting practice, required in London I.E. Dept., for the planning, estimating, and supervision of Street Lighting projects. Applications, stating experience, qualifications, and age, to Siemens Electric Lamps and Supplies, Limited, 38/39, Upper Thames-street, E.C.4.

The Development of the Tungsten Lamp

In these days when we hear so much of fluorescent lamps we are perhaps inclined to overlook the important contribution made to our well-being by the tungsten lamp. The following is a report of a recent lecture by Dr. B. P. Dudding who has been closely associated with the development of the tungsten lamp for many years.

The tungsten filament lamp is now so much the most widely used of all light sources that the present-day lighting engineer is all too disposed to take it very much for granted; the ultra-modern have even begun to treat it somewhat condescendingly, as worthy of respect mainly on account of services rendered in the past. The truth is that this lamp, as we know it to-day, is the result of an immense amount of ingenuity in design and of skill in manipulation so that it far surpasses any other light source, past or present, in the delicacy and complexity of the processes involved in its manufacture.

The story of the many changes which have taken place in the course of the lamp's development during the past half century was most fascinatingly described to members of the Illuminating Engineering Society by Dr. B. P. Dudding at the Society's meeting on December 12. He said that no fewer than four distinct industries were involved: there was the glass industry which provided the bulbs and the internal structure used for mounting the filament, the metal industry which provided the filament and its immediate supports, the industry responsible for the gases used for filling the bulb and, finally, the industry in which all these items were combined to produce the complete article.

In the old carbon filament lamp the life was determined mainly by the blackening of the bulb, which reduced the light output fairly rapidly. Lamps were considered to have completed their useful life when the candle-power had fallen to about 80 per cent. of its original value, and were designed to have lives of 400 or 800 hours on this basis, according to the efficiency obtained, which was about 2.4 or 2.25 lumens per watt respectively. A later development, the so-called metallised carbon filament, gave 2.7 lm/w. The introduction of the metal filament was a great step forward and by 1920 the efficiency of the 40-watt lamp had risen to 8.1 lm/w. The gas-filled lamp was introduced immediately after the first World War and, although the efficiency was appreciably higher only in the larger wattage ratings, it soon ousted the vacuum lamp in the smaller sizes as well because of its whiter light. When a standard specification for tungsten filament lamps was in preparation, about the year 1921, there were many discussions on the value of the objective average life to be adopted. Finally an average of rather more than 1,000 hours was chosen as the best compromise between many conflicting requirements, and the subsequent development of the tungsten lamp took place against this background.

Dr. Dudding then showed some photographs taken in a lamp factory about the year 1900. Many of the processes involved in making a lamp were carried out by hand at this period, but gradually automatic machinery was introduced. This immediately brought to light variations in the properties of the glass used for making the stems, variations which had passed unnoticed as long as the stems had been made individually by hand. Steps had to be taken to improve

the uniformity of the glass used and these led finally to the production of glass tubing by automatic machinery.

Turning next to the metallurgical side of the lamps, the lecturer said that, quite apart from the filament itself, there were problems involved in the production and use of leading-in wires and filament supports. For example, in 1912 a nickel-iron alloy was introduced to replace the platinum which had previously been used at the "pinch" where the leading-in wires passed through the glass. As regards the filament itself, squirted tungsten wire, first made in Austria in 1904, was used for a time, but this type of filament was fragile and in 1910 Coolidge developed a method of preparing drawn tungsten wire. The tungsten powder was packed and sintered so as to form an elongated ingot, and this was reduced by hammering to a long rod about one millimetre in diameter from which the fine wire needed for the filament was obtained by repeatedly drawing it through diamond dies of ever increasing fineness.

At first the mounting of the filaments (which might be as little as one-third of a "thou." in diameter) was done entirely by hand; later, machine winding was introduced. A great deal of research was put into the metallurgy of the filament to increase its efficiency and to prevent deformation and early failure; it was found, for instance, that the introduction of 0.75 per cent. of thoria prevented the crystals from slipping transversely and so removed one of the common causes of premature fracture in the squirrel-cage type of lamp which held the field from 1904 till 1919.

The final great advance in the development of the tungsten lamp was the introduction of gas-filling. It was found that the cooling effect of the gas could be greatly reduced by coiling the filament. This was strikingly demonstrated by the lecturer, who had a coiled filament mounted in a long tube filled with gas. The current was adjusted so that the filament was quite bright when in its original coiled state; it was then pulled out and was seen to become duller and duller owing to the increased cooling as the coils became more and more open.

At first the coiled filaments were found to sag and become distorted during life owing to the high temperature of operation, but once more the metallurgist came to the rescue by developing a non-sag tungsten filament which remained practically unchanged in form throughout the 1,000 hours of operation of the lamp. This, however, was not the only modification necessitated by gas-filling. Hitherto, the glass principally used in the construction of lamps had been ordinary soda glass, but at the higher temperatures reached in a gas-filled lamp this showed appreciable conduction with resultant failure at the pinch.

The phenomenon was very neatly demonstrated by means of a lamp mounted in series with a soda-glass rod which, of course, interrupted the circuit at ordinary temperatures. When the rod was heated, however, the lamp was seen to light up as the softening point of the glass was approached and its electrical resistance rapidly diminished. For gas-filled lamps, therefore, a special glass had to be produced.

The coiled filament being so much shorter than the straight wire, it was necessary to attain very high accuracy in mounting, and automatic machines were developed to supersede the hand mounting originally employed. Further, the gas used for filling the bulbs had to be of a very high degree of purity, especially as regards elimination of the slightest trace of oxidising gas, and this problem at first taxed the resources of the chemist very severely.

Dr. Dudding then went on to describe the development of bulb-making, from the old blowing process, known to the ancient Egyptians, to the introduction in 1919-20 of a machine which automatically imitated the movements of the glass-blower but produced bulbs at a very much faster rate. Once again the introduction of automatic machinery made it necessary to secure greater uniformity in the material used, and by 1930 the machines had doubled their output owing to improvements in the glass itself. In all the other processes such as exhausting and gas-filling, capping and ageing there was the same progressive change from hand to automatic operation. Side by side with this went the introduction of control chart technique; in fact, the lamp industry was the first in this country to introduce standardised methods of control at different stages during the course of manufacture. These had resulted in very great savings; at the time when they were introduced the rejections might be as many as 60 for every 100 lamps placed on the market, whereas now they seldom exceeded five.

The lecturer concluded by paying tribute to the work done by the many who in this country, on the continent of Europe, and in America had worked together to make the tungsten lamp the really wonderful piece of apparatus that it had become.

Correspondence

School Lighting

To the Editor, LIGHT AND LIGHTING.

Sir,—What is wrong with modern school lighting? In "Statutory Rules and Orders 1945, No. 345, Regulations Prescribing Standards for School Premises, Artificial Light," there are only two requirements; (1) enough light, (2) that no luminous part of any "light fitting" shall be less than 9 ft. above the floor.

Now, owing to economy in building, "light fittings" cannot be installed much over 9 ft. above the floor of a classroom. So, without statutory limitations for brightness, glare may be serious.

But, says one salesman, note the low brightness of diffusing spheres. And the answer may be, can we afford as much as 35 per cent. of the total light output in an upward direction.

Another salesman says that his fittings are more efficient; house lower wattage lamps for the required value of illumination. So the question of "efficiency" and brightness returns.

The I.E.S. Code may be produced; likewise British Standard Code of Practice CP 324.102 (1948). But, unfortunately, strongest arguments appear to be statutory orders.

And compliance with present Statutory Rules and Orders does not necessarily ensure satisfactory seeing conditions for normal eyes in classrooms.—Yours, etc.,

W. H. JONES, F.I.E.S., A.M.I.E.E.

Northampton.

To the Editor, LIGHT AND LIGHTING.

Sir,—Your interesting issue for January, 1951, carries a school lighting article on which a comment from our American experience may be helpful. The author says, "If, as we believe, children's eyesight is something worth taking care of, a good case can be made out for the use of photo-electric cells for switching on the lights automatically as daylight fades."

In the first relighting of the Bowditch model classroom, Salem, Mass., in 1945, a simple method of accomplishing this result at nominal expense was demonstrated. A small pocket-sized footcandle meter was fastened to the first desk in the middle row and the numerical scale was eliminated. The needle was covered by a mask containing two windows—one marked "Turn On" and the other marked "Turn Off." The location of the windows was calibrated to the room so that the needle appeared in the "On" window when the daylight illumination had fallen enough so that the artificial lighting was needed. The addition of the artificial light caused the needle to disappear again behind the mask. If the daylight became stronger, to the point where the artificial lighting could be turned off, the needle would appear at the "Off" window.

The child to whose desk the meter was fastened served as light monitor of the room and took care of the switching of the lights as indicated, without any disturbance to the teacher or the rest of the class. It was found that children as young as six years of age could do this without its interfering with their school work after the first day or two when the novelty had worn off.

It can be argued that this method is actually superior to automatic electronic control because it gives the children an opportunity to participate in the operation of the room. There is also a practical advantage on days when clouds are passing frequently between the sun and the schoolroom, when automatic control would continue to switch the lights on and off. A child monitor can be instructed to leave the lights on under such circumstances.

It may seem to make my story a waste of space to admit that there was actually very little public interest shown in this feature of the model classroom. I do not know of the idea having been adopted elsewhere. On the other hand, there has been very little actual use made of fully automatic equipment for switching of the lights in the U.S. The cost of automatic equipment is so great in most cases as to reduce the amount of money which can be spent on the lighting itself. Therefore I recommend that in any case where automatic control does become a real issue, monitored control should be considered instead.—Yours, etc.,

WILLARD ALLPHIN, F.I.E.S. (U.S.A.).

Massachusetts.

I.E.S. Television Studio Visit

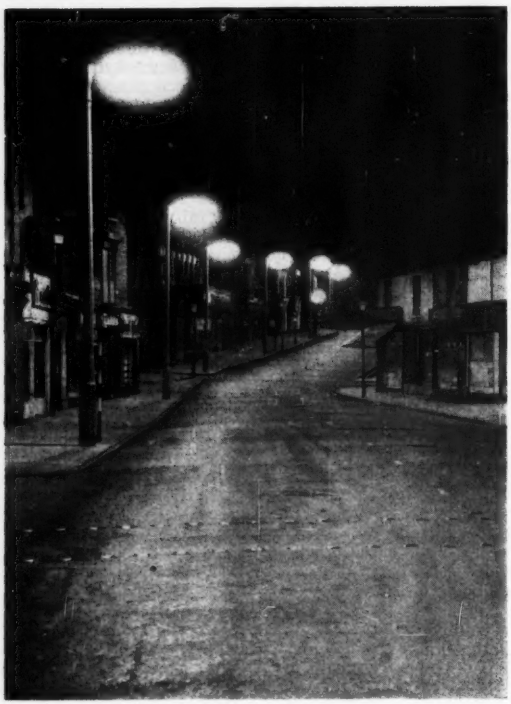
We are asked to announce that a visit for I.E.S. members has been arranged to the new B.B.C. Television Studios at Lime Grove. The visit, which is strictly limited in numbers, will take place on the afternoon of Wednesday, March 28. Those wishing to take part should communicate with the Secretary, The I.E.S., 32, Victoria-street, London, S.W.1.

Recent Street Lighting Installations

Chorley

A new streetlighting installation covering some three miles of the A6 main road from London to Carlisle and Inverness where it passes through the Borough of Chorley, Lancashire, was recently switched on. Nearly three-quarters of a mile in the town centre are lighted by fluorescent lamps. The remainder of the road within the borough boundaries is lighted with sodium lamps.

All the lanterns, fluorescent and sodium lamps and control gear have been supplied by The General Electric Co. Ltd., whose lighting engineers collaborated with the designer of the scheme, Mr. H. D. C. Lowe, M.I.Mun.E., Borough Engineer and Surveyor of Chorley Corporation. The erection was carried out by W. J. Furse and Co. (Manchester), Ltd. All the lamps are swtiched on and off by the A.T.E. Rhythmatic system operated from a central control point at a substation.

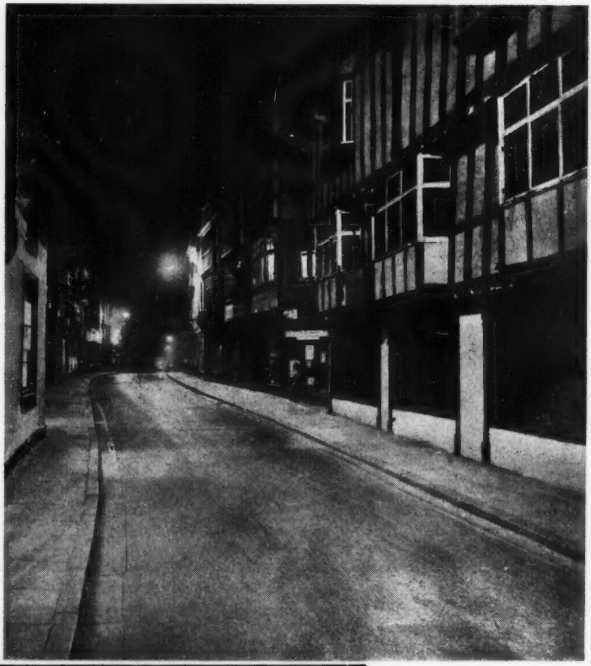


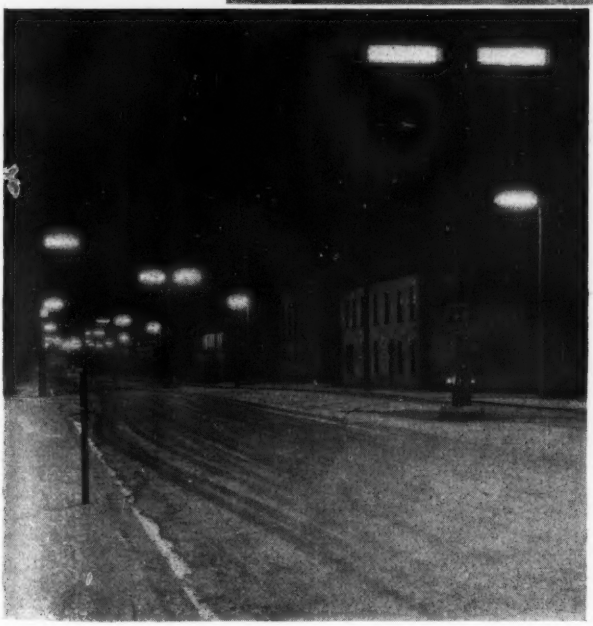
The 112 sodium and 32 fluorescent lanterns in the scheme are mounted on 25-ft. Concrete Utilities "Avenue 3D" columns at an average spacing of 112 ft. The light outputs per 100 ft. of road are 5,700 lumens in the fluorescent section and 6,000 lumens in the sodium section.

Each sodium lantern contains one 140-watt sodium lamp. The three daylight colour fluorescent lamps in each of the fluorescent lanterns are arranged in a "V" formation that in conjunction with the special refractor system of light control makes the lantern appear uniformly light all over when viewed from street level.

Evesham

The advantages of mounting lanterns on brackets fixed to the walls of adjacent property in narrow streets are well demonstrated by a new installation at Bridge Street, Evesham. Revo lanterns housing sodium lamps on wall brackets are relatively inconspicuous compared with the effect that might justly have been achieved had lighting columns been installed. In picturesque places such as Evesham it is essential for the character of the streets and buildings to be retained.





Newtownards

A new installation comprising of 169 *Class A Wilton Sieray* 3*-ft.* 80*-watt lanterns has recently been completed at Newtownards, near Belfast. The main road, which is* 60-80 *ft. wide has been divided into two separate carriageways by spacing double arm units and single sided units at* 120-150 *ft. apart. The columns are manufactured by Concrete Utilities, in Hilton Red sand and incorporate a special fluorescent lantern head,*

Trafford Park

The adjacent photograph shows the new lighting on the Westinghouse Road flanking the northern boundary of the main Trafford Park Works of Metropolitan-Vickers Electrical Co. Ltd. "Trafford" lanterns are erected on steel columns down one side only of each of the two carriageways.

Leamington

The Parade in the Royal Borough of Leamington Spa has a scheme of fluorescent streetlighting involving 35 *B.T.H. lanterns each housing three* 80-*watt* 5-*ft. lamps. The units are mounted centrally at a height of* 25 *ft. on Stanton* 6G *columns, spaced at intervals of* 100-120 *ft. giving an even spread of illumination over the road and pavements. An interesting feature of this installation is the use of tungsten lamps in the base of the columns behind armour glass, enabling the columns to act as illuminated signs separating the streams of traffic.*

Chester

A streetlighting installation that enables some famous architectural features to be seen in their full beauty and at the same time affords excellent road surface illumination, has been brought into use in St. Werbergh Street, Chester. The lanterns employed are the new G.E.C. vertical pattern for four 5-ft. 80-watt lamps, which have been specially designed to harmonise with the architecture of civic centres and similar surroundings by day, as well as to show such buildings to the best advantage at night. The installation was carried out by the Merseyside and North Wales Electricity Board.

Bombay—

Chowpatty Seaface is one of the few places in Bombay where there is a sand beach and in consequence it is a popular resort. The Bombay Municipality recently remodelled the road on the sea front to provide double carriage ways, each 40 ft. wide and divided by a 5 ft. strip, with footpaths 15 ft. wide. The Municipality decided to improve the lighting of this drive, and has installed 14 G.E.C. "Three-Eighty" lanterns on the strip between the carriageways, mounted at a height of 25 ft. and spaced 130 ft. apart. Each lantern is equipped with three 5-ft. 80-W. daylight colour fluorescent lamps.

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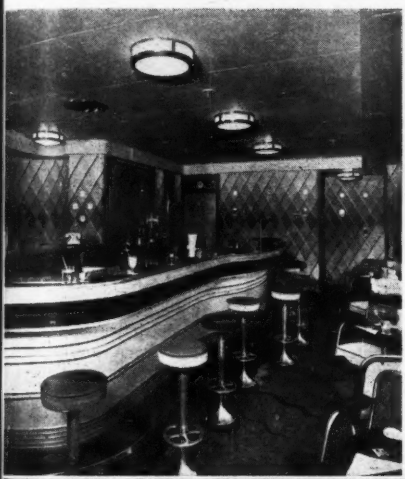
New Lighting Installations

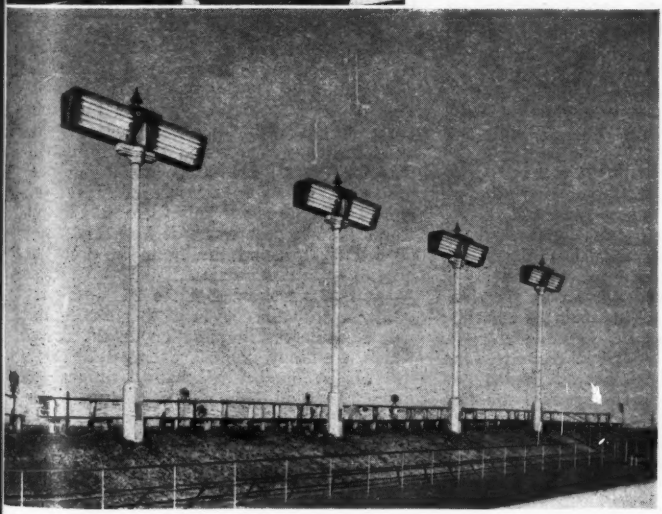
- **Cocktail Bar**
- **Swimming Bath**
- **Rayon Shed**
- **B.E.A. Control Centre**
- **B.E.A. Conference Room**



Cocktail Bar

The B.T.H. Company, Ltd., supplied the lighting fittings for this new "Mermaid Bar" in R.M.S. Queen Mary. The units—nine in all—have a polished silver bronze framework and satin finished glass dish. Their overall diameter is 17 inches with a depth of five inches and each fitting houses three 60-watt tungsten filament lamps. The fittings are arranged in a regular pattern in two lines running the length of the bar and give a pleasing and evenly distributed light of the order of 8—10 lm/ft.^{2} Contractors for the installation were Messrs. G. T. Rackstraw, Ltd., of Worcester.

(Above). The Mermaid Bar aboard R.M.S. Queen Mary.



(Left). The Vanderbijl Park swimming bath showing some of the specially designed lanterns.

Lighting in a creping and winding shed by 5-ft. fluorescent lamps mounted at 10 ft. from ground level.

Swimming Bath

A lighting installation recently carried out at an open air swimming bath at Vanderbijl Park, Johannesburg, by the G.E.C., Ltd., is of special interest at the present time on account of the attention being paid by public authorities to outdoor lighting for the Festival of Britain. Eleven fittings of special design are mounted on columns round the perimeter of the bath, each containing six 5-ft. 80-watt "daylight" colour fluorescent lamps. The lamps are mounted in two groups of three in front of individual parabolic reflectors. The central portion of each fitting contains a 300-watt tungsten lamp arranged to light the area behind the columns.

Rayon Shed

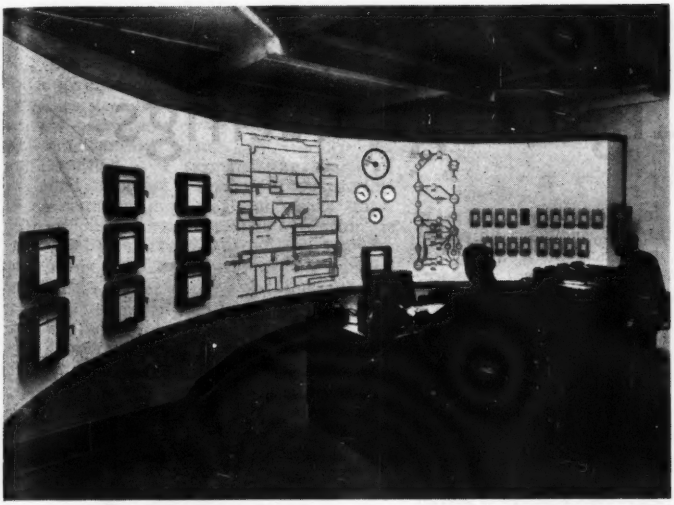
The lighting of the creping and winding shed of Messrs. Mark Nutter, Ltd., of Skipton, has recently been redesigned by Metropolitan-Vickers Electrical Co., Ltd. One of the problems to be overcome was the difficulty experienced in seeing the shining rayon thread which in creping is vibrating and moving at speed. This difficulty is made worse by the poor background to the thread. Extensive trials were carried out in the shed for over six months before adopting a general layout which provides an even illumination over the whole floor area.

The fittings house 5-ft. 80-watt "natural" fluorescent lamps and give an average illumination of 14 lm/ft.^{2}

B.E.A. Control Centre

Three control rooms at the new Grid Control Centre of the British Electricty Authority at Paternoster-square have been equipped by the G.E.C., Ltd., with fluorescent lighting for illumination of the meter and mimic diagram panels, and general lighting of the rooms. This centre houses the National Control Room for the whole of the British Grid System, and the Thames North and Thames South Area Controls.

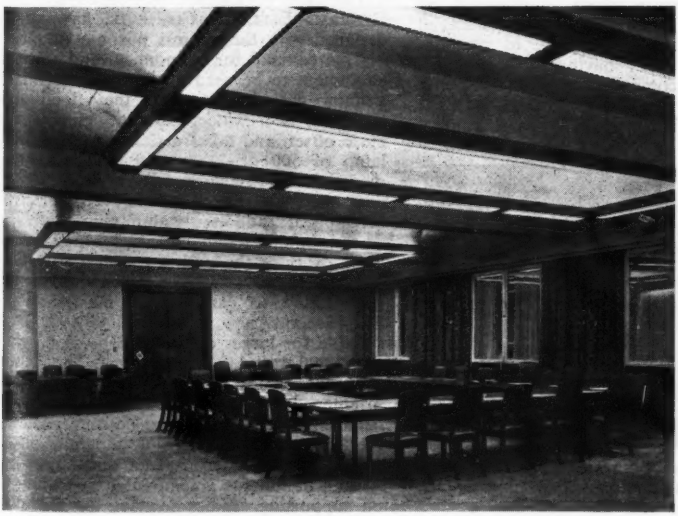
The general requirement of the lighting in all the control rooms was the even illumination at 25 lm/ft.^{2} of the panels. This has been achieved by using two-lamp angle fittings with louvres, mounted 3 ft. away from the boards and 1 ft. 6 in. higher than their tops. The fittings are in continuous rows following the curvature of the panels, and in the Thames North Control Room, which has panels at both ends, are carried right round the room in order to provide even illumination of the whole area. Measurements show that the 25 lm/ft.^{2} required are obtained even at the base of the panels, while the illumination on the desks, which is entirely indirect, averages 10 to 15 lm/ft.^{2}. A number of channel fittings are mounted behind the panels to light the upper parts of the walls and ceiling so as to avoid undue contrast between the panels and their surroundings. "Daylight" lamps are used throughout as they give better colour discrimination.



View of the meters and mimic diagrams illuminated by angle fittings in the National Control Room of the B.E.A

B.E.A. Conference Room

Fluorescent lighting in two of the main conference rooms at the headquarters of the British Electricity Authority in Oxford-street, London, is sited in conform approximately with the layout of the conference tables; 25-35 lm/ft.^{2} are achieved on the tables, falling off to a minimum of 8 – 10 lm/ft.^{2} round the edges of the rooms. The installation consists of a series of twin 80-watt 5-ft. fluorescent lamps built into simple rectangular plaster features. Direct glare is avoided by the use of the opaque plaster sides and "egg-crate" louvre panels. There is also ample indirect light to brighten the upper parts of the rooms, thereby adding to the apparent height and spaciousness of the rooms. The installation was designed by the B.T.H. Co., Ltd., in collaboration with the architects, Messrs. Norman and Dawbarn.

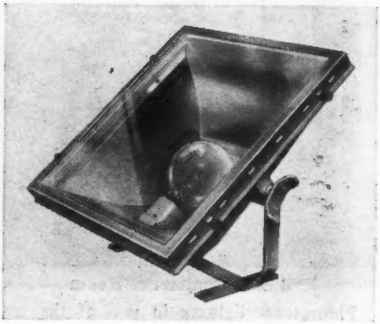


Showing the specially designed fluorescent lighting in a conference room at the B.E.A. headquarters.

Lighting Fittings

New fittings introduced by COURTNEY, POPE (ELECTRICAL), LTD., include a fitting for use in interiors in which the conventional fluorescent fitting would look out of place. This fitting (illustrated) makes use of a circular 80-watt fluorescent lamp in the bowl for indirect lighting with a 150-watt tungsten lamp giving direct lighting through a louvre. The fitting is made in spun aluminium. Normally the control gear is housed away from the fitting but, if necessary, a special ceiling fixture to take the gear can be supplied. This firm has also produced two new mirror lighting fittings for use in the fitting rooms of shops or stores, in hotels and elsewhere. One unit houses two 2-ft. 20-watt fluorescent lamps which enable lamps of different colours to be used to give the required blend, and the other unit may be used with either two 30-watt or 60-watt tungsten striplamps or two 2-ft. 20-watt fluorescent lamps. A new development in lighting materials known as "Contralux," for use with laylights and lighting fittings, has been introduced by this firm in collaboration with PLYGLASS, LTD. A third dimension effect is obtained by arranging two layers of spun glass material between the outer glasses, one of which is clear and the other having a "pin-head" finish. A honeycomb pattern is obtained with a cut-off effect similar to a metal egg-crate louvre. "Contralux" gives a certain amount of sparkle to the light and also reduces the brightness ratios. The light transmission factor is about 65 per cent. but this varies with the colour of the spun glass used.

This new fitting houses a circular 80-w. fluorescent lamp and a 150-w. tungsten lamp.



A wide-angle floodlight for close offset specially designed for use in connection with the Festival of Britain.

The new floodlights introduced by THE GENERAL ELECTRIC CO., LTD., have been designed with the express purpose of meeting the demand for economical and efficient equipment to be used during the Festival of Britain period. One of the floodlights (F.69042) is a wide-angle type suitable for close offset, and takes a Class B.1 projector lamp of 500 or 1,000 watt. The body is made of sheet-steel, rust-proofed and stove-enamelled, and the reflectors are of electro-brightened, anodised aluminium. The frame holding the flat, toughened front glass overlaps the body in such a way that there is an air space for ventilation of the lamp but water cannot enter the floodlight. The second new floodlight (F.69023) is suitable for larger offsets, and uses 500-watt or 1,000-watt G.L.S. lamp. The spun aluminium body is anodised and electro-brightened on the inside to form the reflector. A cast aluminium housing encloses the lampholder, and the floodlight is fitted with a flat, toughened front glass.

Both floodlights are mounted in trunnions on supporting cradles so that the angle of

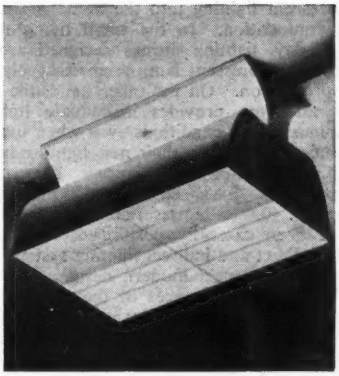
throw can be adjusted, and they can be fitted with colour screens.

A new G.E.C. fitting specially designed for a gymnasium has a substantial body of 18-gauge steel, and is equipped with metal louvres preventing direct view of the two 200-watt tungsten lamps with which the unit is fitted. A special arrangement of flat and inclined louvres produces this effect without impairing the wide angle distribution of light. The reflector is attached by two screws at each end to the ceiling-mounted top flare containing the two E.S. lampholders. Two slots running the length of the reflector at the top permit upward light to reach the ceiling. The fitting may be arranged for surface or recessed conduit wiring.

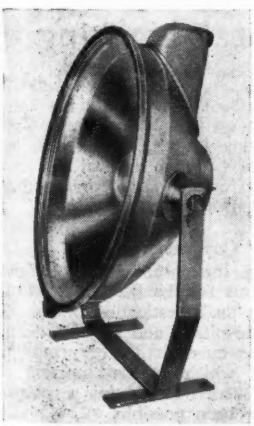
A new 50-watt fitting has been designed by METROPOLITAN-VICKERS ELECTRICAL CO., LTD., for the illumination of gauge glasses in oil refineries and for other special applications in fume-laden atmospheres.

The fitting has a cast iron or silicon aluminium conduit box with lugs for 5/16th Whitworth bolts and a reinforcing boss tapped ¾-in. conduit on the side of the box ensures a vapour tight conduit entry to the terminal block in the casting. Two Edison screw or bayonet cap porcelain lampholders are mounted on circular metal plates separated by wiring channels, and this assembly is screwed to brass pillars in the conduit box with one plate covering the mouth of the box to form a cool wiring chamber. Wiring between lampholder and terminal block is carried out with asbestos-covered cambric insulated wire.

The lamp housing is a cast iron or silicon aluminium cylinder with a recessed heat-resisting glass panel and a packing ring to ensure a vapour-tight joint when the housing is screwed to the box by the knurled retaining collar. Two 25-watt tubular lamps are used in the unit, which has an overall height of 12½ in. by 3⅜ in. diameter.



New fitting specially designed for a gymnasium.



Another floodlight designed by the G.E.C. and suitable for larger offsets.

A fluorescent industrial trough fitting of unusual universal adaptability has recently been designed by NEW ERA INDUSTRIES (TOTTENHAM), LTD. This fitting is instant start incorporating the use of two Tungsten Ballast Lamps in spun aluminium reflectors (one at each end of the trough) and the main illumination is afforded by means of twin 40-watt 4-ft. (single contact) fluorescent lamps within the reflector. This is in sheet steel and finished stove enamel white on the reflecting surface, and as required on the outside. A top longitudinal channel running the whole length of the fitting, serving as a wiring channel, has conduit knockouts at both ends and also centrally on both long sides, thus making the unit readily adaptable for existing surface conduit installations.

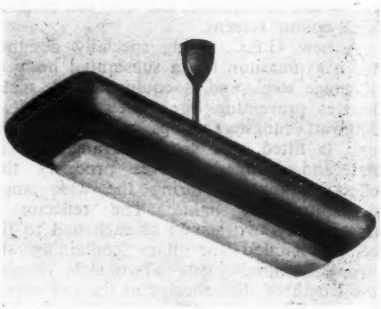
A unique feature is its ready use for ceiling mountings where concealed conduit systems and boxes exist. In this instance means are provided for a main fixing direct to the conduit box with subsidiary fixings at each end to ensure flush fixing to the ceiling. Further adaptability is by the provision, if necessary, of a suitably designed metal Pattras for use on existing surface conduit systems where existing tungsten lighting points are to be replaced by fluorescent lighting, and where surface conduit boxes are in use.

One problem in the introduction of

fluorescent lighting into the home is that of accommodation. In the small living room of to-day, lighting fittings designed around the 4-ft. fluorescent lamp seem strangely out of proportion. On the other hand, the 2-ft. 20-watt lamp provides inadequate lighting for most home conditions even when used in groups of four. In their new lighting fitting (GK/4240) illustrated, THORN ELECTRICAL INDUSTRIES, LTD., have therefore adopted the 2-ft. 40-watt lamp. Four of these lamps have been carefully positioned, in a combined direct and indirect lighting system, in a fitting of compact modern design.

The external surfaces of the reflector are finished in a glossy coinage bronze colour and the inner surfaces are in stove enamelled white. The diffuser tray is in .030 opal "Perspex." The circuit includes double glow starter switches, the lamps being connected in series pairs. Peach or warm white lamps are recommended for this fitting, an efficient combination being warm white lamps in the outer positions for indirect lighting and peach in the centre positions for direct lighting. For suspension, a small slotted saddle carrying a terminal block for mains connections is screwed to the ceiling. The fitting hooks into this and the cover slides into place. Including purchase tax, but excluding lamps, the fitting is being marketed at £12 0s. 8d.

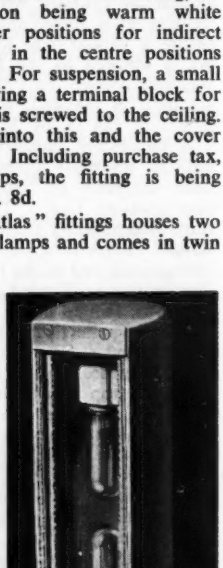
Another new "Atlas" fittings houses two 80-watt fluorescent lamps and comes in twin



This Atlas fitting for domestic use incorporates four 2-ft. 40-w. lamps.

form. Although the control gear and chassis are the same, the one-piece diffuser of "Perspex" is available either in a louvre or a clear reeded design. Opal "Perspex" end-caps and a special shallow chassis produce an impression of a translucent light source without "works" suspended in mid-air.

Special attention has been given to the light distribution and the fitting is remarkably free from end shadows or dark patches on the ceiling above. While the choice of diffuser is largely a matter of taste, the louvre design, FJL/2080, is particularly applicable to stores, commercial premises and showrooms where high level display lighting, combined with artistic appearance of the fitting is important. Price of this unit, including purchase tax, is £26 1s. 6d.



Designed for lighting gauge glasses, this Metrovick fitting houses two 25-w. tubular lamps.

Hospital Lighting

(*Continued from page* 92)

colour is used the choice is rather a compromise as although the Mellow lamp gives a more pleasing atmosphere from the patient's point of view, the medical staff may prefer a Natural quality lamp for examination due to superior colour rendering.

Conclusion

In conclusion, the author wishes to give acknowledgements to The B.T.H. Co., Ltd., for encouraging the investigation of lighting conditions in hospitals and for providing facilities for the manufacture of prototype fittings without which the development of this new and successful lighting technique would not have been possible.

I.E.S. ACTIVITIES

London

At the sessional meeting in London on February 13, Mr. H. W. Cumming presented a paper entitled "The Extension of the Gas Arc Condition." The paper described a continuation of the work on the gas arc which was covered by Dr. J. N. Aldington in a paper to the I.E.S. a year or two ago.

After a preliminary section in which the derivation of the term "Gas Arc" was indicated, empirical data on the electrical and luminous characteristics of arc discharges through the rare gases xenon, krypton, argon, neon and helium were given.

Three distinct types of xenon discharge lamp were described. The first form is designed to constrict the arc by employing relatively small bore tubing for the envelope and to allow the dissipation of a high wattage water-cooling means are provided; the original 5,000-watt type XA/U lamp, more commonly known as the 5,000-watt gas arc lamp, is of this construction. A new lamp, type XB/U, rated at 1,000 watts, has been developed as a result of this experimental work; it operates with normal air cooling and has a comparatively long life. The third type of lamp is based on a construction similar to the well-known high pressure compact source mercury lamp; data is provided on the relationships between arc luminance and (i) current at constant gas pressure and (ii) gas pressure at constant arc current. The limitations on the use of very high gas pressures in practical lamps were discussed.

The characteristics of the commercially available XA/U and XB/U lamps were given together with data on percentage luminance in the usual eight spectral bands, luminous efficiency, life and physical dimensions. The radiation from an arc discharge in an atmosphere of xenon is shown to be of daylight quality, having an energy distribution very close to a total radiator at some 5,500 degs. K.; it follows that the radiation has accurate colour-rendering properties. The quality of the radiation is found to remain sensibly constant over a wide range of wattage loading for a given lamp and is produced in this form, at full intensity, immediately the lamp is switched on; there is no "run-up" period. Circuits were described for starting and operating xenon lamps from normal mains supplies whereby the arc can be switched in or out at will.

Applications for the xenon arc lamps were indicated. The type XA/U and XB/U lamps have been employed for colour matching and colour comparison work where high levels of illumination are required, for the acceleration of fading tests and for experimental studies of certain types of plant growth. A powerful continuous spectrum extending down to some 2,000°A in the ultra-violet is present in the radiation and has been of interest for the promotion of photochemical studies; the 5,000-watt lamp has also been used as a powerful source in infra-red photography. The more compact sources are shown to be suitable for the projection of colour films and colour slides; in the higher wattage sizes such lamps may be used for Morse signalling.

Birmingham Centre

At a sessional meeting of the Birmingham Centre held on January 5, 1951, a paper, entitled "Commercial Lighting of Big Stores and Shops," was given by Mr. L. E. Gibbs to an audience of about eighty members and visitors.

Mr. Gibbs said that commercial shop lighting came under three headings:—(1) The multiple shop; (2) big store lighting; and (3) the individualist shop and small trader.

The chief requirements for the first were good general illumination and display lighting using a standard type of fitting, thus allowing easy replacement and service at the many branches of these stores in the big cities. It is necessary to convey to the public the type and class of goods sold such as by the use of bare tubes on batten fittings insinuating that this was an inexpensive store catering for the economically minded.

The large retail store could present most difficult problems, as each floor was usually broken down into sections carrying different goods. This usually resulted in one section being adequately and suitably lighted, while the neighbouring section, probably with dark show cases and goods, looked totally inadequate. The lighting engineer must therefore work in close co-operation with store management.

Mr. Gibbs said the individual shop was a different proposition. There were no hard-and-fast rules of standardisation and there was variation from a small single-fronted shop to the substantially large premises found in most towns. High efficiency in

lighting often came second to a harmonious and symmetrical appearance.

The speaker went on to compare the merits of different types of lamps and said that, generally speaking, the hot cathode fluorescent lamp was the best proposal, followed by tungsten and cold cathode lighting, although each had their merits for a particular job. Mr. Gibbs went on to discuss the types of lighting required for various kinds of shops.

During the discussion which followed, a number of speakers regretted the almost universal use of the fluorescent tube with its awkward shape and bad colour rendering. Mr. Gibbs countered this by saying that research was still going on, and answers would eventually be found to all criticisms. He also suggested that as most of us had grown up with the tungsten lamp, a certain amount of bias existed towards it.

The vote of thanks to the author was proposed by Mr. H. B. Mellor and seconded by Mr. G. R. Hanson.

The Birmingham Centre have two excellent social functions each year, a ladies night and an annual dinner at which the company is entirely male. This year's annual dinner was held on January 12, at the Imperial Hotel, Birmingham, when 160 members and guests were present. The Centre chairman, Mr. F. Penson, was unfortunately indisposed and the duties of chairman were ably conducted by the vice-chairman of the Centre, Mr. R. A. Lovell.

In the speeches following the dinner the toast of the Society was proposed by Mr. D. H. Kendon, chairman of the South Midland Centre of the I.E.E., who said it was most appropriate that the I.E.E. should be associated with the I.E.S., as to-day illumination was mainly provided by electricity. Great developments had taken place in the efficiency of electric lamps, and at the same time the cost of electricity had been reduced so that the cost of light was now very much lower than even a few years ago. We were, however, more appreciative of the need for good lighting and levels of illumination had increased. He recalled that when metal filament lamps were first introduced some people forecast that as a result of their increased efficiency the supply industry would suffer on account of decreased consumption —instead of which the increased popularity of the better lamps had led to the increased prosperity of the supply industry. Though the work of the illuminating engineer had been made more difficult in so far as he now had to keep pace with constant new developments his task in supplying cheap and efficient light had been made easier. The Society had played a considerable part in these achievements and had focused attention on the need to use new sources efficiently.

Mr. Davies, replying to the toast, recalled the many fields of activity in addition to that of lighting practice which were represented in the membership of the Society. It was the wide interests of its members that had enabled the Society to take such an important part in the development of lighting in this country, and it was certain that development in the efficient use of new light sources would not have been so rapid had it not been for the existence of the Society.

Mr. Lovell proposed the toast of the guests and said how glad the Centre was to welcome the president, Mr. L. J. Davies. He also said that the Centre took not a little pleasure from the fact that it was one of their members who was this year's Faraday Lecturer. The Centre were glad to welcome as their guests Mr. D. H. Kendon, who, in addition to his connection with the I.E.E., was also deputy chairman of the Midlands Electricity Board, Mr. H. J. Manzoni, City Engineer and Surveyor of Birmingham, Alderman Lewis, chairman of the Midlands Electricity Board, together with representatives of the Birmingham Electric Club, the Electrical Contractors Association, the Association of Supervising Electrical Engineers, and the chairman of the Nottingham Centre and the Stoke-on-Trent Group of the Society.

Mr. H. J. Manzoni replied on behalf of the guests, and also paid tribute to the I.E.S. and its work, saying that it had a difficult task which it was tackling very well. There were many obstructions, he said, to its efforts to secure a better recognition of the need of good lighting—a typical example being the recent ban on shop window lighting which, apart from a few weeks in midwinter, was really an off-peak load. Unfortunately, he said, it was felt necessary to impose this restriction to impress the public with the seriousness of the present fuel situation.

After the speeches members and guests were entertained by a number of excellent artistes.

Newcastle Centre

The annual dinner of the Newcastle Centre was held at the County Hotel, Newcastle, on January 10 when a large number of members and guests were present.

The guests were welcomed by the chairman of the Centre, Mr. J. S. McCulloch, who said how glad the members were to welcome the president, Mr. L. J. Davies,

particularly as he had many other duties this year, not the least of which was the Faraday Lecture. He also extended a welcome to other guests, including Mr. P. J. Ryle, chairman of the N.W. Section of the I.E.S., and Mr. Clive Newcombe president of the Northern Architectural Association.

Mr. Clive Newcombe, replying on behalf of the guests, said that his profession was closely allied with that of the illuminating engineer and they appreciated the advances in illuminating engineering which had taken place in recent years. He said it seemed only a few years ago that electricity supply companies would approach the builder or architect of new houses or premises and ask if they could be allowed to install electric lighting.

The toast of the I.E.S. was proposed by Mr. P. J. Ryle, who said that it should be remembered that the object to be lighted is frequently as important as the light which fell upon it; for instance the possibilities of floodlighting were hardly appreciated although it might well be that some buildings could be designed with a view to their appearance at night being enhanced by floodlighting. He also thought there was considerable scope for better lighting in shops, particularly in connection with colour rendering; it was not necessary for special colour-matching lamps to be used provided the goods or garments were used under lighting similar to that under which they were bought. With the multitude of different colours of lamps now in use this was becoming an important matter.

The reply on behalf of the Society was made by Mr. L. J. Davies who said that the strength of the Society lay in the very wide interests of its members, and he was very glad to see the close contacts that the Newcastle Centre had with the engineering, electrical and architectural professions.

The remainder of the evening was given over to entertainment.

Sheffield Centre

The December meeting of the Sheffield Centre was as usual held in the Medical Library, Sheffield University, on Monday, December 4, at 6 p.m., when Mr. S. Anderson lectured on "Control Gear for Fluorescent Lamps."

The lecturer restricted his paper to the development of the hot cathode type of fluorescent lamp. It was mentioned that the first fluorescent lamps were produced during the first years of the last war, when production limitations made it necessary to supply gear of general utility manufacture, instead of specialised design, hence large unsightly chokes and condensers which had to be concealed wherever possible. Modern equipment is less affected by voltage variations, is more aesthetic in design and more efficient in operation. Early in the lecture the factors affecting the starting and operating voltages at supply frequency were dealt with, along with the need for pre-heating of the cathodes up to emission temperature.

Resistive control with non-inductive ballast-resistances was fully explained, mention being made of the comparatively high losses with this method of control, although filament lamps are now being utilised as ballast giving a more trouble-free operation at a slightly reduced efficiency. Comparisons under operating conditions between inductive and capacitive ballasts was also a very interesting feature of the lecture, illustrating comparative effects of steadily reduced voltage on light efficiency down to minimum operating voltages and later on the ascending scale with restriking voltages. The use of instant-start circuits with either inductive or capacitive control was similarly fully outlined. An interesting discussion ensued at the conclusion of the lecture.

Forthcoming I.E.S. Meetings

LONDON

March 13th

Sessional Meeting. (Joint meeting with R.I.B.A.) "Recent Research in Daylighting," by W. A. Allen and R. G. Hopkinson. (At the Lighting Service Bureau, 2, Savoy Hill, W.C.2.) 6 p.m.

CENTRES AND GROUPS

March 5th

"The Lighting of Departmental Stores," by A. W. Jervis. (Joint Meeting with the Leeds Chamber of Commerce.) (At the Lighting Service Bureau, 24, Aire Street, Leeds, 1.) 7 p.m.

March 5th

"Railway Light Signalling System," by G. G. F. Halliwell. (At the Medical Library, The University Weston Bank, Sheffield, 10.) 6 p.m.

March 7th

"The Design of Lighting Fittings," by W. R. Stevens. (At the Minor Durrant Hall, Oxford Street, Newcastle-on-Tyne, 1.) 6.15 p.m.

March 7th

"Electric Lighting—A Contractor's Viewpoint," by J. Ashmore. (At the Electricity Showrooms, Market Street, Huddersfield.) 7.15 p.m.

March 8th

"The Problems Associated with Underground Lighting in British Coal Mines," by D. A. Strachan. (At the School of Mines, Treforest.) 5.45 p.m.

March 8th

"Hospital Lighting," by M. W. Peirce and D. J. Reed. (At the Demonstration Theatre, East Midlands Electricity Board, Leicester Sub-Area, Charles Street, Leicester.) 6.30 p.m.

March 9th

Annual General Meeting. "Light and Vision," by H. C Weston. (At the Imperial Hotel, Temple Street, Birmingham.) 6 p.m.

March 14th

Annual General Meeting. Presidential Address, by L. J. Davies. (At the Welfare Club Hall of the City of Edinburgh Lighting and Cleansing Department, High Street, Edinburgh.) 7 p.m.

March 15th

Annual General Meeting. Presidential Address, by L. J. Davies, followed by Annual Dinner. (Place to be announced.) 6 p.m.

March 20th

"Home Lighting," by Dr. J. N. Aldington. (At the Lecture Theatre, Merseyside and North Wales Electricity Board's Service Centre, Whitechapel, Liverpool, 1.) 6 p.m.

POSTSCRIPT

By "Lumeritas"

More than once I have referred to the complaints of ill-effects which are occasionally made against fluorescent lighting. Some of these alleged ill-effects have been attributed, both here and in America, to the emission of ultra-violet radiation. Among the suggested consequences of exposure to fluorescent radiations have been baldness, sterility, vitamin deficiency, dermatitis, and cutaneous burns! Imagine my surprise, then, on seeing a full-page advertisement, in an American lighting journal, of a fluorescent sun lamp, by which "For the first time, wide areas can be bathed practically and economically with *beneficial* ultra-violet rays." The advertisement goes on to say, "At a relatively close range, it's ideal for tanning"; but "tanning" is precisely what an American medical writer meant by "cutaneous burning" when he recently reported in the medical Press a few cases of such "burns." This new fluorescent lamp, we are told, has "five times the output . . . of the conventional bulb-type sun lamp." How very odd it is that the ordinary fluorescent lamp, with its weak ultra-violet radiation, should be so harmful, while the new fluorescent lamp, with its strong ultra-violet radiation, should be so beneficial!

Two new books have just been published on the subject of vision in industry. One is called "Eyes and Industry," while the other is called "Eyes in Industry," so some confusion between them may well arise. The first of these books is by an American author, and the second is by British authors. Both books have a chapter on the obviously relevant and important subject of lighting, but the authors would have done well to have had these chapters expertly "vetted" and to have been more accurate in quoting from other works.

Last month I mentioned Mr. Robinson's recent paper upon "Brightness Engineering," in which he quoted the American "Q and Q" Committee Report to the effect that for the best seeing conditions brightness ratios in the visual field should be unity. The statement that ideally the brightness of the surrounds should be equal to the brightness of the object of view is becoming hackneyed: it is said that this principle has been established by scientific research. On the face of it the statement is nonsense, and I believe that those who make it have misinterpreted some of the researches upon which they rest it. In the correspondence columns of the January issue of "Illuminating Engineering," Mr. H. L. Logan criticises not only this statement but also the "Q and Q" Committee's "rule" that, for good seeing brightness ratios in the visual field should not exceed three to one. I think Mr. Logan has done well to query these "rules," although, of course, I am not suggesting that high brightness ratios ought not to be avoided.

In my January notes I mentioned Sir John Parson's recent criticism of British railway station name signs, on the grounds that the letters are too small and that the contrast between them and their background is insufficient. Endorsement of Sir John's criticism has come quickly from one of our learned judges, as will be seen from the following report, which I quote in full, from the *Daily Telegraph* of February 14:—

"Mr. Justice Stable said at York Assizes yesterday that he would like to see the names of railway stations in bigger letters. 'I constantly deplore the passionate anonymity displayed by railway stations in this island.

"'It makes travelling infinitely more interesting and educational, even in an express train, if you can clearly read the names of the stations that you go through.

"'There is not a single soul who has ever travelled by train who has not experienced difficulty in discovering where he or she has got to from time to time. Why we do not have the names of stations in big letters on seats and lamps so that everyone can see, I do not know.'

"He awarded damages of £308 13s. 5d. to Lilian Starkey, 70, of Gresham-road, Middlesbrough. She said that she was injured by a fall between the platform and a train when, because of bad lighting, she alighted at Cargo Fleet, Yorks, station, under the impression that she had arrived at Middlesbrough."

Actually the size and contrast required depends, of course—within certain limits—upon the illumination of the name sign. The accident reported occurred through failure to recognise the station "because of bad lighting."